Product specification

Robot stopping distances according to ISO 10218-1
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Original instructions.

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Specifications subject to change without notice.
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Overview of this specification

About this specification
This specification contains stopping distances and times for category 0 and category 1 stops, as required by EN ISO 10218-1 Annex B.

Usage
This specification should be used when calculating the safe distance in applying safeguarding devices.

Who should read this manual?
This specification is intended for:
- Personnel working with planning of robot systems

References
Documentation referred to in the manual, is listed in the table below.

<table>
<thead>
<tr>
<th>Document name</th>
<th>Document ID</th>
</tr>
</thead>
<tbody>
<tr>
<td>Safety manual for robot - Manipulator and IRC5 or OmniCore controller</td>
<td>3HAC031045-001</td>
</tr>
<tr>
<td>Product specifications for the respective robots</td>
<td></td>
</tr>
<tr>
<td>Standard: EN ISO 10218-1, Annex B</td>
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This manual contains all safety instructions from the product manuals for the manipulators and the controllers.

Revisions

<table>
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<tr>
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<th>Description</th>
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<tr>
<td>A</td>
<td>Release 14.1. The following robots are added:</td>
</tr>
<tr>
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<td>• IRB 120</td>
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<tr>
<td></td>
<td>• IRB 140</td>
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<tr>
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<td>• IRB 6700</td>
</tr>
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<td>• IRB 260</td>
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<td>• IRB 660</td>
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<td>• IRB 460</td>
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<td>• IRB 760</td>
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<td>B</td>
<td>Release 15.1. The following robots are added:</td>
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<tr>
<td></td>
<td>• IRB 6700 variants</td>
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<tr>
<td></td>
<td>• IRB 1200</td>
</tr>
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<td></td>
<td>• IRB 1520</td>
</tr>
<tr>
<td></td>
<td>• IRB 1600</td>
</tr>
<tr>
<td></td>
<td>Descriptions about the data and measurements are updated.</td>
</tr>
<tr>
<td>C</td>
<td>Release 15.2. The following robots are added:</td>
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<td></td>
<td>• IRB 2400</td>
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<table>
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<tr>
<th>Revision</th>
<th>Description</th>
</tr>
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</table>
|          | - IRB 4400  
           - IRB 8700  
|          | **Note**  
Category 0 values are missing for IRB 7600 2.80 m 340 kg.  
The following robots are added:  
- New variants for IRB 1600ID  
This revision includes the following additions and/or changes:  
- A description of how to measure the stopping distance and time for your installation is added, see *Measuring stopping distance and time on page 17.*  
- Rename of the new variant IRB 1600ID - 6/1.55 to IRB 1660ID - 6/1.55.  
- Re-inserted IRB 1600ID-4/1.5 that was missing in the previous revision.  
| F        | Release 16.2.  
- Improved measurements for 4-axis articulated robots.  
- Category 0 values are added for IRB 7600 340/2.80.  
| G        | Release 17.2.  
- Updated data for all previously published robots.  
- Added information about naming conventions, see *Naming of product variants in this document on page 15.*  
- The following robots are added:  
  - IRB 360  
  **Note**  
For stop category 0, the robot may hit the mechanical stops before the speed is reduced to 0.  
  - IRB 6700inv  
| H        | Release 19A.  
The following robots are added:  
- IRB 6790  
- IRBP K, IRBP L, IRB R  
  **Note**  
Data for IRBP C will be added in a later release.  
| J        | The following robots are added:  
- IRB 910SC  
| K        | The following robots are added:  
- IRBP A, IRBP B, IRBP D  
- Corrected names in tables for IRBP R.  
| L        | The following robots are added:  
- IRB 910INV  
- IRB 1100  
- IRBP C  
| M        | Added back IRB 2600, that was accidentally removed from revision L.  

*Continues on next page*
<table>
<thead>
<tr>
<th>Revision</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>Added correct graphics for IRB 2600. The graphics used in revisions J to M are not correct.</td>
</tr>
<tr>
<td>P</td>
<td>Release 20C. The category 0 stop data for all IRBP is updated with graphics. The following robots are added: • IRB 1300</td>
</tr>
<tr>
<td>Q</td>
<td>Release 20C. The following robots are added: • IRB 760, 445 kg variant The description about measurement and calculation is updated.</td>
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<tr>
<td>R</td>
<td>Release 21A. The following robots are added: • IRB 390</td>
</tr>
<tr>
<td>S</td>
<td>Release 21B. The following robots are added: • CRB 1100 • CRB 15000</td>
</tr>
<tr>
<td>T</td>
<td>Release 21C. The following robots are added: • IRB 920 The graphs for IRB 1660ID are corrected.</td>
</tr>
<tr>
<td>U</td>
<td>Release 22A. The following robots are added: • IRB 1300-12/1.4 • IRB 5710 • IRB 5720 The robot IRB 260 is removed as it is phased out from the official product offer.</td>
</tr>
<tr>
<td>V</td>
<td>Release 22B. The following robots are added: • IRB 365</td>
</tr>
<tr>
<td>W</td>
<td>Release 22C. The following robots are added: • IRB 1010 • IRB 920, new variants</td>
</tr>
<tr>
<td>X</td>
<td>Release 22D. The following robots are added: • CRB 1300</td>
</tr>
<tr>
<td>Y</td>
<td>Release 23A. • IRB 365, new variants • The robot IRB 140 is removed as it is phased out from the official product offer. • The robot IRB 6640 is removed as it is phased out from the official product offer.</td>
</tr>
<tr>
<td>Z</td>
<td>Release 23B. • The data for the CRB 15000 and IRB 5710/5720 robots is moved to their respective product specification. All documents are available on <a href="http://www.abb.com/robotics">www.abb.com/robotics</a>. The data for new robots is included in their respective product specification.</td>
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### Overview of this specification

**Continued**

<table>
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<td>AA</td>
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<td>• IRB 1510</td>
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<td>The data for the CRB 1100, CRB 1300, IRB 1010, IRB 1100, IRB 1300, IRB 910INV, and IRB 920 robots is moved to their respective product specification. All documents are available on <a href="http://www.abb.com/robotics">www.abb.com/robotics</a>.</td>
</tr>
<tr>
<td></td>
<td>The data for new robots is included in their respective product specification.</td>
</tr>
</tbody>
</table>
1 About the data

Robot stopping distances and times

For articulated and SCARA robots, all measurements and calculations of stopping distances and times are done according to ISO 10218-1, with single axis motion on axes 1, 2, and 3. If more than one axis is used for the movement, then the stopping distance and time can be longer. Normal delays of the hardware and software are taken into account.

For delta robots (parallel arm) the values are based on movement by all axes, as these axes always move together. Only stopping times are presented.

For positioners the values are based on single axis movement.

The stop categories 0 and 1 are according to IEC 60204-1.

Category 0 stops

The stopping distance and time for category 0 stops are simulated using maximum speed, maximum payload, and the arm stretched out to the maximum reach.

Note

For SCARA robots without brakes on axis 1 and 2, the stopping distances for category 0 stops in actual applications can be longer than those stated in this document because without brakes, it is the friction that will stop the robot (on axes without brakes).

Category 1 stops

The stop category 1 data are based on calculations in simulation of worst case scenarios. The data for stop category 1 are verified by measurements.

The simulations and verifications are done with the default value (100%) for the system parameter AccSet. Changing this value will affect the stopping distances and times (only for robots running on versions prior to RobotWare 6.01).

Note

The stop category 1 is a controlled stop and will therefore have less deviation from the programmed path compared with a stop category 0.

Robots

For robots the stopping distance and time for category 1 stop is provided for three arm extensions and three payloads. These variables are 100%, 66%, and 33% of the maximum values for the robot.

The speed and zone data in the simulations are based on TCP0.

Positioners

For positioners the stopping distance and time is provided for three payloads. No extension zones are applicable. The payloads are 100%, 66%, and 33% of the maximum values for the positioner.

Continues on next page
Positioners with more than one station are presented with only one station data as the stations are identical.

Loads

The used loads represent the rated load, with rated inertia in the load diagram, maximum cog z, and zero cog x and cog y. No arm load is used. The load diagrams are available in the respective product specification.

At 66% load and 33% load, the mass and inertia are reduced to 66% and 33% but cog z is the same as for 100% load.

Extension zones for articulated robots

The extension zone for the stop category 1 is based on the wrist center point (WCP). The extension zone limits describe the size of the respective zones. Radius R is measured from the axis-1 center.

<table>
<thead>
<tr>
<th>Zone 0 (Z0)</th>
<th>Zone 1 (Z1)</th>
<th>Zone 2 (Z2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Radius (R) is 0-33% of maximum reach of the wrist center point (WCP).</td>
<td>Radius (R) is 33-66% of maximum reach of the wrist center point (WCP).</td>
<td>Radius (R) is 66-100% of maximum reach of the wrist center point (WCP).</td>
</tr>
</tbody>
</table>

Speed

For robots the TCP0 speed is measured in meters per second when the stop is triggered.

For positioners the speed is the angular speed in radians per second.

Stopping distances

The stopping distance is measured in degrees.

**Note**

The stopping distances are presented as angles. Large angles with TCP0 close to the rotation center do not necessarily correspond to a long stopping distance. Therefore a large stop angle can represent a short TCP stop distance.

**Note**

The stopping distance for delta robots is measured in meters.

Stopping times

The stopping time is measured in seconds.
Limitations

The stopping distance can vary depending on additional loads on the robot.
The stopping distance for category 0 stops can vary depending on the individual brakes and their friction.
This document includes the robot variants that are part of the official product offer at the time of the release of this revision.

Naming of product variants in this document

The product variants presented in this document are named according to their reach and capacity. This corresponds to their official variant name but there are a few exceptions where the names do not match due to different data sources. For example, IRB 6650S 125/3.5 is listed as IRB 6650S 3.45 m 125 kg.
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2 Measuring stopping distance and time

Preparations before measuring
For measurement and calculation of overall system stopping performance, see ISO 13855:2010.

The measurement shall be done for the selected stop category. The emergency stop button on the robot controller is configured for stop category 0 on delivery. A risk assessment can conclude the need for another stop category. The stop category can be changed through the system parameter Function (topic Controller, type Safety Run Chain). In case of deviations of the default configuration of stop category 0, then this is detailed in the product specification for the respective manipulator.

CAUTION
The measurement and calculation of overall stopping performance for a robot must be tested with its correct load, speed, and tools, in its actual environment, before the robot is taken into production.
All load and tool data must be correctly defined (weight, CoG, moment of inertia). The load identification service routine can be used to identify the data.

CAUTION
Follow the safety instructions in the respective product manual for the robot.

Measuring with TuneMaster
The software TuneMaster can be used to measure stopping distances and times for ABB robots. The TuneMaster software contains documentation on how to use it.

1 Download TuneMaster from www.abb.com/robotics, section RobotStudio - Downloads - RobotWare Tools and Utilities.
2 Install TuneMaster on a computer. Start the TuneMaster app and select Log Signals.
3 Connect to the robot controller.
4 Define the I/O stop signal to use for measurement, for example, ES1 for emergency stop.
5 Define the signal number to use for measurement, 1298 for axis position. The value is given in radians.
6 Start the logging in TuneMaster.
7 Start the test program on the controller.
8 When the axis has reached maximum speed, press the emergency stop button.
9 In TuneMaster, measure the stopping distance and time.
10 Repeat for all installed emergency stop buttons until the identified hazards due to stopping distance and time for axes have been verified.

Continues on next page
Example from TuneMaster
3 IRB 120

3.1 IRB 120 0.58 m 3 kg

Category 0

The following table describes the stopping distance and time for category 0 emergency stop at max speed, with the arm stretched out to the maximum with maximum load. All results are from tests on one moving axis.

<table>
<thead>
<tr>
<th>Axis</th>
<th>Distance (degrees)</th>
<th>Stop time (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>28.9</td>
<td>0.15</td>
</tr>
<tr>
<td>2</td>
<td>32.8</td>
<td>0.17</td>
</tr>
<tr>
<td>3</td>
<td>27.4</td>
<td>0.12</td>
</tr>
</tbody>
</table>

Category 1, extension zones

For definitions of the zones, see Extension zones for articulated robots on page 14.

<table>
<thead>
<tr>
<th>Zone</th>
<th>wcp min (m)</th>
<th>wcp max (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0.193</td>
</tr>
<tr>
<td>1</td>
<td>0.193</td>
<td>0.387</td>
</tr>
<tr>
<td>2</td>
<td>0.387</td>
<td>max reach</td>
</tr>
</tbody>
</table>

Category 1, Axis 1

Extension zone 0, stopping distance and stopping time

![Graph showing stopping distance and time for category 0 emergency stop]

Continues on next page
3 IRB 120

3.1 IRB 120 0.58 m 3 kg

Continued
Extension zone 2, stopping distance and stopping time

Continued
Category 1, Axis 2

Extension zone 0, stopping distance and stopping time

The diagrams show the relationship between speed (v [m/s]) and stopping distance (\( \Phi \) [°]) and stopping time (t [s]) for different mass percentages (m=100%, m=66%, m=33%).
Extension zone 1, stopping distance and stopping time

![Graph](image1)

![Graph](image2)

Continues on next page
3 IRB 120

3.1 IRB 120 0.58 m 3 kg

Continued

Extension zone 2, stopping distance and stopping time

![Graphs showing stopping distance and time with different masses (100%, 66%, 33%) against velocity (v [m/s]).]
Category 1, Axis 3

Extension zone 0, stopping distance and stopping time

---

**Graphs:**

Top graph:
- Shows the relationship between $\Phi$ (in degrees) and $v$ (in m/s) for different values of $m$ (100%, 66%, 33%).

Bottom graph:
- Shows the relationship between $t$ (in seconds) and $v$ (in m/s) for the same values of $m$. The lines for each $m$ value are distinct, indicating how stopping time changes with speed and mass percentage.

---

Continues on next page
Extension zone 1, stopping distance and stopping time

3.1 IRB 120 0.58 m 3 kg

Continued
Extension zone 2, stopping distance and stopping time

![Graph showing stopping distance and time for IRB 120 robot]
Category 0

The following table describes the stopping distance and time for category 0 emergency stop at max speed, with the arm stretched out to the maximum with maximum load. All results are from tests on one moving axis.

<table>
<thead>
<tr>
<th>Axis</th>
<th>Distance (degrees)</th>
<th>Stop time (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>28.6</td>
<td>0.14</td>
</tr>
<tr>
<td>2</td>
<td>33.2</td>
<td>0.17</td>
</tr>
<tr>
<td>3</td>
<td>27.3</td>
<td>0.12</td>
</tr>
</tbody>
</table>

Category 1, extension zones

For definitions of the zones, see *Extension zones for articulated robots on page 14*.

<table>
<thead>
<tr>
<th>Zone</th>
<th>wcp min (m)</th>
<th>wcp max (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0.193</td>
</tr>
<tr>
<td>1</td>
<td>0.193</td>
<td>0.387</td>
</tr>
<tr>
<td>2</td>
<td>0.387</td>
<td>max reach</td>
</tr>
</tbody>
</table>

Category 1, Axis 1

Extension zone 0, stopping distance and stopping time
Extension zone 1, stopping distance and stopping time

Continues on next page
Extension zone 2, stopping distance and stopping time

Graphs showing stopping distance and time vs. velocity for different mass percentages (m=100%, m=66%, m=33%).
Category 1, Axis 2

Extension zone 0, stopping distance and stopping time
Extension zone 1, stopping distance and stopping time

![Graph showing stopping distance and time for IRB 120T 0.58 m 3 kg with different masses (100%, 66%, 33%) at various velocities (0.0 to 3.0 m/s).]
Extension zone 2, stopping distance and stopping time

Continued
Category 1, Axis 3

Extension zone 0, stopping distance and stopping time

![Graph showing stopping distance and stopping time for different masses (m=100%, m=66%, m=33%) with varying velocities (v)]
Extension zone 1, stopping distance and stopping time

---

Continues on next page
Extension zone 2, stopping distance and stopping time

![Graph 1](image1)

![Graph 2](image2)
4 IRB 910

4.1 IRB 910SC 0.45 m 3 kg

Category 0

The following table describes the stopping distance and time for category 0 emergency stop at max speed, with the arm stretched out to the maximum with maximum load. All results are from tests on one moving axis.

<table>
<thead>
<tr>
<th>Axis</th>
<th>Distance (degrees)</th>
<th>Stop time (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>42.9</td>
<td>0.21</td>
</tr>
<tr>
<td>2</td>
<td>72.2</td>
<td>0.22</td>
</tr>
<tr>
<td>3</td>
<td>3.98</td>
<td>0.16</td>
</tr>
</tbody>
</table>

Category 1, extension zones

For definitions of the zones, see Extension zones for articulated robots on page 14.

<table>
<thead>
<tr>
<th>Zone</th>
<th>wcp min (m)</th>
<th>wcp max (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0.15</td>
</tr>
<tr>
<td>1</td>
<td>0.15</td>
<td>0.3</td>
</tr>
<tr>
<td>2</td>
<td>0.3</td>
<td>max reach</td>
</tr>
</tbody>
</table>

Category 1, Axis 1

Extension zone 0, stopping distance and stopping time

![Graph showing stopping distance and time](image)
4 IRB 910

4.1 IRB 910SC 0.45 m 3 kg

Continued
Extension zone 2, stopping distance and stopping time

![Graph showing stopping distance and time vs velocity for IRB 910SC 0.45 m 3 kg](image)

Continued
Category 1, Axis 2

Extension zone 0, stopping distance and stopping time

---

4 IRB 910

4.1 IRB 910SC 0.45 m 3 kg

Continued
Extension zone 1, stopping distance and stopping time

- **Graph 1:**
  - Y-axis: $P_h$ [°]
  - X-axis: $v$ [m/s]
  - Lines represent different mass fractions: $m=100\%$, $m=66\%$, $m=33\%$

- **Graph 2:**
  - Y-axis: $t$ [s]
  - X-axis: $v$ [m/s]
  - Lines represent different mass fractions: $m=100\%$, $m=66\%$, $m=33\%$
Extension zone 2, stopping distance and stopping time

![Graphs showing Phi and t vs. v for different mass levels (m=100%, m=66%, m=33%).]

Continues on next page
Category 1, Axis 3

Extension zone 0, stopping distance and stopping time

---

Product specification - Robot stopping distances according to ISO 10218-1

Continues on next page
4 IRB 910

4.1 IRB 910SC 0.45 m 3 kg

Continued

Extension zone 1, stopping distance and stopping time

---

Continues on next page
Extension zone 2, stopping distance and stopping time

![Graph 1: \( P_h \) vs. \( v \)]

- \( m = 100\% \)
- \( m = 66\% \)
- \( m = 33\% \)

![Graph 2: \( t \) vs. \( v \)]

- \( m = 100\% \)
- \( m = 66\% \)
- \( m = 33\% \)
4.2 IRB 910SC 0.55 m 3 kg

Category 0

The following table describes the stopping distance and time for category 0 emergency stop at max speed, with the arm stretched out to the maximum with maximum load. All results are from tests on one moving axis.

<table>
<thead>
<tr>
<th>Axis</th>
<th>Distance (degrees)</th>
<th>Stop time (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>52.75</td>
<td>0.27</td>
</tr>
<tr>
<td>2</td>
<td>71.9</td>
<td>0.23</td>
</tr>
<tr>
<td>3</td>
<td>3.98</td>
<td>0.16</td>
</tr>
</tbody>
</table>

Category 1, extension zones

For definitions of the zones, see Extension zones for articulated robots on page 14.

<table>
<thead>
<tr>
<th>Zone</th>
<th>wcp min (m)</th>
<th>wcp max (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0.183</td>
</tr>
<tr>
<td>1</td>
<td>0.183</td>
<td>0.367</td>
</tr>
<tr>
<td>2</td>
<td>0.367</td>
<td>max reach</td>
</tr>
</tbody>
</table>

Category 1, Axis 1

Extension zone 0, stopping distance and stopping time
Extension zone 1, stopping distance and stopping time

Continues on next page
Extension zone 2, stopping distance and stopping time

![Graph showing stopping distance and time for IRB 910SC 0.55 m 3 kg](image-url)
Category 1, Axis 2

Extension zone 0, stopping distance and stopping time

---

Continues on next page
Extension zone 1, stopping distance and stopping time
Extension zone 2, stopping distance and stopping time

![Graphs showing stopping distance and time for different masses.](image)
4 IRB 910

4.2 IRB 910SC 0.55 m 3 kg

Continued

Category 1, Axis 3

Extension zone 0, stopping distance and stopping time

Continues on next page
Extension zone 1, stopping distance and stopping time

Continues on next page
Extension zone 2, stopping distance and stopping time

![Graph showing stopping distance and stopping time for different masses (m=100%, m=66%, m=33%) at various velocities (v)]
4.3 IRB 910SC 0.65 m 3 kg

Category 0

The following table describes the stopping distance and time for category 0 emergency stop at max speed, with the arm stretched out to the maximum with maximum load. All results are from tests on one moving axis.

<table>
<thead>
<tr>
<th>Axis</th>
<th>Distance (degrees)</th>
<th>Stop time (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>49.33</td>
<td>0.29</td>
</tr>
<tr>
<td>2</td>
<td>66.6</td>
<td>0.22</td>
</tr>
<tr>
<td>3</td>
<td>3.98</td>
<td>0.16</td>
</tr>
</tbody>
</table>

Category 1, extension zones

For definitions of the zones, see Extension zones for articulated robots on page 14.

<table>
<thead>
<tr>
<th>Zone</th>
<th>wcp min (m)</th>
<th>wcp max (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0.217</td>
</tr>
<tr>
<td>1</td>
<td>0.217</td>
<td>0.433</td>
</tr>
<tr>
<td>2</td>
<td>0.433</td>
<td>max reach</td>
</tr>
</tbody>
</table>

Category 1, Axis 1

Extension zone 0, stopping distance and stopping time

![Graph showing stopping distance and time for category 0 emergency stop at max speed with the arm stretched out to the maximum with maximum load. All results are from tests on one moving axis.](image)
4 IRB 910

4.3 IRB 910SC 0.65 m 3 kg

Continued
Extension zone 2, stopping distance and stopping time

![Graphs showing stopping distance and time vs. velocity for different load percentages.]
Category 1, Axis 2

Extension zone 0, stopping distance and stopping time

---

Continues on next page
Extension zone 1, stopping distance and stopping time
4 IRB 910

4.3 IRB 910SC 0.65 m 3 kg

Continued

Extension zone 2, stopping distance and stopping time

[Graphs showing stopping distances and times for different load conditions.]
Category 1, Axis 3

Extension zone 0, stopping distance and stopping time

Graphs showing stopping distances and stopping times for different mass percentages (m=100%, m=66%, m=33%) at various speeds (v [m/s]).
Extension zone 1, stopping distance and stopping time

![Diagram showing stopping distance and time vs. velocity]

Continues on next page
Extension zone 2, stopping distance and stopping time

![Graph showing stopping distance and time vs. velocity for IRB 910 SC 0.65 m 3 kg]
5 IRB 1200

5.1 IRB 1200 0.7 m 7 kg

Category 0

The following table describes the stopping distance and time for category 0 emergency stop at max speed, with the arm stretched out to the maximum with maximum load. All results are from tests on one moving axis.

<table>
<thead>
<tr>
<th>Axis</th>
<th>Distance (degrees)</th>
<th>Stop time (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>32.7</td>
<td>0.14</td>
</tr>
<tr>
<td>2</td>
<td>37.2</td>
<td>0.22</td>
</tr>
<tr>
<td>3</td>
<td>37.6</td>
<td>0.16</td>
</tr>
</tbody>
</table>

Category 1, extension zones

For definitions of the zones, see Extension zones for articulated robots on page 14.

<table>
<thead>
<tr>
<th>Zone</th>
<th>wcp min (m)</th>
<th>wcp max (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0.235</td>
</tr>
<tr>
<td>1</td>
<td>0.235</td>
<td>0.469</td>
</tr>
<tr>
<td>2</td>
<td>0.469</td>
<td>max reach</td>
</tr>
</tbody>
</table>

Category 1, Axis 1

Extension zone 0, stopping distance and stopping time

![Graph showing stopping distance and time](image)

Continues on next page
Extension zone 1, stopping distance and stopping time
Extension zone 2, stopping distance and stopping time

![Graphs showing stopping distance and time vs. velocity](image-url)

- $P_{th}$ vs. $v$ (m/s)
- $t$ vs. $v$ (s)

*Continued on next page*
Category 1, Axis 2

Extension zone 0, stopping distance and stopping time

---

Continues on next page
Extension zone 1, stopping distance and stopping time

![Graph showing stopping distance and time for different mass percentages (m=100%, m=66%, m=33%) against speed (v) for IRB 1200 with a mass of 0.7 m 7 kg.]

Continued on next page
Extension zone 2, stopping distance and stopping time
Category 1, Axis 3

Extension zone 0, stopping distance and stopping time

---

Continued on next page
5 IRB 1200

5.1 IRB 1200 0.7 m 7 kg

Continued

Extension zone 1, stopping distance and stopping time

![Graph of stopping distance and time vs. velocity](image)

Continues on next page
Extension zone 2, stopping distance and stopping time

![Graph showing stopping distance and time for different masses](image)

---

Product specification - Robot stopping distances according to ISO 10218-1

3HAC048645-001 Revision: AA

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5.2 IRB 1200 0.7 m 7 kg

Category 0

The following table describes the stopping distance and time for category 0 emergency stop at max speed, with the arm stretched out to the maximum with maximum load. All results are from tests on one moving axis.

<table>
<thead>
<tr>
<th>Axis</th>
<th>Distance (degrees)</th>
<th>Stop time (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>32.7</td>
<td>0.14</td>
</tr>
<tr>
<td>2</td>
<td>37.1</td>
<td>0.22</td>
</tr>
<tr>
<td>3</td>
<td>37.6</td>
<td>0.16</td>
</tr>
</tbody>
</table>

Category 1, extension zones

For definitions of the zones, see Extension zones for articulated robots on page 14.

<table>
<thead>
<tr>
<th>Zone</th>
<th>wcp min (m)</th>
<th>wcp max (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0.235</td>
</tr>
<tr>
<td>1</td>
<td>0.235</td>
<td>0.469</td>
</tr>
<tr>
<td>2</td>
<td>0.469</td>
<td>max reach</td>
</tr>
</tbody>
</table>

Category 1, Axis 1

Extension zone 0, stopping distance and stopping time

![Graph showing stopping distance and time](image)
Extension zone 1, stopping distance and stopping time
Extension zone 2, stopping distance and stopping time

![Graph showing stopping distance and time vs. velocity for different masses (m=100%, m=66%, m=33%).]
Category 1, Axis 2

Extension zone 0, stopping distance and stopping time

![Graph 1](image1)

![Graph 2](image2)
Extension zone 1, stopping distance and stopping time

![Graph showing stopping distances and times for different masses]

Continued
Extension zone 2, stopping distance and stopping time

![Graph showing stopping distance and stopping time for different mass values.](image)

Continues on next page
Continues on next page
Extension zone 1, stopping distance and stopping time

![Graph showing stopping distance and time versus speed for different mass percentages (m=100%, m=66%, m=33%).]
Extension zone 2, stopping distance and stopping time

![Graph showing stopping distance and stopping time for different masses m=100%, m=66%, m=33% against velocity v in m/s.](image-url)
Category 0

The following table describes the stopping distance and time for category 0 emergency stop at max speed, with the arm stretched out to the maximum with maximum load. All results are from tests on one moving axis.

<table>
<thead>
<tr>
<th>Axis</th>
<th>Distance (degrees)</th>
<th>Stop time (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>39.1</td>
<td>0.19</td>
</tr>
<tr>
<td>2</td>
<td>45.8</td>
<td>0.29</td>
</tr>
<tr>
<td>3</td>
<td>42.1</td>
<td>0.2</td>
</tr>
</tbody>
</table>

Category 1, extension zones

For definitions of the zones, see Extension zones for articulated robots on page 14.

<table>
<thead>
<tr>
<th>Zone</th>
<th>wcp min (m)</th>
<th>wcp max (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0.3</td>
</tr>
<tr>
<td>1</td>
<td>0.3</td>
<td>0.601</td>
</tr>
<tr>
<td>2</td>
<td>0.601</td>
<td>max reach</td>
</tr>
</tbody>
</table>

Category 1, Axis 1

Extension zone 0, stopping distance and stopping time

![Graph showing Phi vs. v for different mass loads (m=100%, m=66%, m=33%)](image)
5 IRB 1200

5.3 IRB 1200 0.9 m 5 kg
Continued

Extension zone 1, stopping distance and stopping time

Continues on next page
Extension zone 2, stopping distance and stopping time

![Graph showing stopping distances and times for different masses](image)

Continues on next page
5 IRB 1200

5.3 IRB 1200 0.9 m 5 kg

Continued

Category 1, Axis 2

Extension zone 0, stopping distance and stopping time

Continues on next page
Extension zone 1, stopping distance and stopping time

![Graph 1: Stopping distance vs. velocity](image1)

![Graph 2: Stopping time vs. velocity](image2)

Continued
Extension zone 2, stopping distance and stopping time

![Graph of stopping distance and time vs. velocity]

- $P_h$ [°] vs. $v$ [m/s]
- $t$ [s] vs. $v$ [m/s]

Legend:
- $m=100\%$
- $m=66\%$
- $m=33\%$
Category 1, Axis 3

Extension zone 0, stopping distance and stopping time

![Graphs showing stopping distances and times for different masses and velocities.](image)
Extension zone 1, stopping distance and stopping time

![Graph showing stopping distance and time for IRB 1200 with masses of 5 kg, 0.9 m, and different speeds.](image-url)
Extension zone 2, stopping distance and stopping time

![Graph showing stopping distance and time for different mass loads](image)

- **Extension zone 2**
- **Stopping distance** and **stopping time**

**Graph Details**

- **Axes**:
  - **x-axis**: Speed (v [m/s])
  - **y-axis**:
    - **Top graph**: Stopping angle (θ) [°]
    - **Bottom graph**: Stopping time (t) [s]

- **Curves**:
  - **m=100%**
  - **m=66%**
  - **m=33%**

**Note**: The graphs illustrate the relationship between speed and stopping characteristics for different mass loads.
Category 0

The following table describes the stopping distance and time for category 0 emergency stop at max speed, with the arm stretched out to the maximum with maximum load. All results are from tests on one moving axis.

<table>
<thead>
<tr>
<th>Axis</th>
<th>Distance (degrees)</th>
<th>Stop time (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>39.1</td>
<td>0.19</td>
</tr>
<tr>
<td>2</td>
<td>45.6</td>
<td>0.29</td>
</tr>
<tr>
<td>3</td>
<td>41.9</td>
<td>0.2</td>
</tr>
</tbody>
</table>

Category 1, extension zones

For definitions of the zones, see Extension zones for articulated robots on page 14.

<table>
<thead>
<tr>
<th>Zone</th>
<th>wcp min (m)</th>
<th>wcp max (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0.3</td>
</tr>
<tr>
<td>1</td>
<td>0.3</td>
<td>0.601</td>
</tr>
<tr>
<td>2</td>
<td>0.601</td>
<td>max reach</td>
</tr>
</tbody>
</table>

Category 1, Axis 1

Extension zone 0, stopping distance and stopping time
Extension zone 1, stopping distance and stopping time

Continued
Extension zone 2, stopping distance and stopping time
Category 1, Axis 2

Extension zone 0, stopping distance and stopping time

![Graph showing stopping distance and time for IRB 1200.](image)

**5.4 IRB 1200 0.9 m 5 kg**

*Continued*
Extension zone 1, stopping distance and stopping time

![Graph showing stopping distance and time vs. velocity]

- $P_{th}$ [°C]
- $t$ [s]

Legend:
- $m=100\%$
- $m=66\%$
- $m=33\%$

$v$ [m/s]

Continued
Extension zone 2, stopping distance and stopping time

[Graph showing stopping distance and time for different load conditions]

Continues on next page
Category 1, Axis 3

Extension zone 0, stopping distance and stopping time
Extension zone 1, stopping distance and stopping time

![Graphs showing stopping distance and time vs. velocity for different load percentages (m=100%, m=66%, m=33%).]
Extension zone 2, stopping distance and stopping time

Graph 1: Stopping distance $P_{hi}$ vs. velocity $v$

Graph 2: Stopping time $t$ vs. velocity $v$
The following table describes the stopping distance and time for category 0 emergency stop at max speed, with the arm stretched out to the maximum with maximum load. All results are from tests on one moving axis.

<table>
<thead>
<tr>
<th>Axis</th>
<th>Distance (degrees)</th>
<th>Stop time (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>26.2</td>
<td>0.34</td>
</tr>
<tr>
<td>2</td>
<td>19.4</td>
<td>0.2</td>
</tr>
<tr>
<td>3</td>
<td>14.0</td>
<td>0.15</td>
</tr>
</tbody>
</table>

### Category 1, extension zones

For definitions of the zones, see [Extension zones for articulated robots on page 14](#).

<table>
<thead>
<tr>
<th>Zone</th>
<th>wcp min (m)</th>
<th>wcp max (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0.481</td>
</tr>
<tr>
<td>1</td>
<td>0.481</td>
<td>0.962</td>
</tr>
<tr>
<td>2</td>
<td>0.962</td>
<td>max reach</td>
</tr>
</tbody>
</table>

### Category 1, Axis 1

Extension zone 0, stopping distance and stopping time

![Graph showing stopping distance and time for different load conditions](image)
Extension zone 1, stopping distance and stopping time
Extension zone 2, stopping distance and stopping time

![Graph showing stopping distances and times for different masses](image-url)
Category 1, Axis 2

Extension zone 0, stopping distance and stopping time

Continues on next page
Extension zone 1, stopping distance and stopping time

![Graph 1](image1.png)

![Graph 2](image2.png)

Continued on next page.
Extension zone 2, stopping distance and stopping time
Category 1, Axis 3

Extension zone 0, stopping distance and stopping time

![Graph 1](image1)

![Graph 2](image2)
Extension zone 1, stopping distance and stopping time

![Graph 1: Stopping distance (P_t) vs. velocity (v)]

![Graph 2: Stopping time (t) vs. velocity (v)]
Extension zone 2, stopping distance and stopping time

![Diagram showing stopping distance and time vs velocity](image)

- For extension zone 2, the stopping distance and time are plotted against velocity.
- The graphs show the relationship between velocity (v [m/s]) and stopping distance (s [m]) or stopping time (t [s]).
- The graphs are labeled with different masses (m=100%, m=66%, m=33%).
This page is intentionally left blank
The following table describes the stopping distance and time for category 0 emergency stop at max speed, with the arm stretched out to the maximum with maximum load. All results are from tests on one moving axis.

<table>
<thead>
<tr>
<th>Axis</th>
<th>Distance (degrees)</th>
<th>Stop time (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>20.2</td>
<td>0.22</td>
</tr>
<tr>
<td>2</td>
<td>18.5</td>
<td>0.17</td>
</tr>
<tr>
<td>3</td>
<td>15.0</td>
<td>0.12</td>
</tr>
</tbody>
</table>

**Category 1, extension zones**

For definitions of the zones, see *Extension zones for articulated robots on page 14.*

<table>
<thead>
<tr>
<th>Zone</th>
<th>wcp min (m)</th>
<th>wcp max (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0.5</td>
</tr>
<tr>
<td>1</td>
<td>0.5</td>
<td>1.0</td>
</tr>
<tr>
<td>2</td>
<td>1.0</td>
<td>max reach</td>
</tr>
</tbody>
</table>

**Category 1, Axis 1**

Extension zone 0, stopping distance and stopping time

Continues on next page
Extension zone 1, stopping distance and stopping time
Extension zone 2, stopping distance and stopping time

![Graphs showing stopping distance and time for different masses.](image-url)
Category 1, Axis 2

Extension zone 0, stopping distance and stopping time

![Graph showing stopping distances and times for different load percentages](image)

---

Continues on next page
Extension zone 1, stopping distance and stopping time

![Graph showing stopping distance and time versus velocity]

Continued
7 IRB 1510

7.1 IRB 1510ID 1.5 m 4 kg

Continued

Extension zone 2, stopping distance and stopping time

![Graph showing stopping distance and time for different mass percentages](image)

Continues on next page
Category 1, Axis 3
Extension zone 0, stopping distance and stopping time
Extension zone 1, stopping distance and stopping time

\[ \Phi_t \quad [^\circ] \]

\[ v \quad [\text{m/s}] \]

\[ m=100\% \]
\[ m=66\% \]
\[ m=33\% \]

\[ t \quad [\text{s}] \]

\[ v \quad [\text{m/s}] \]

\[ m=100\% \]
\[ m=66\% \]
\[ m=33\% \]
Extension zone 2, stopping distance and stopping time

Graphs showing the relationship between velocity (v [m/s]) and stopping distance (P [m]) or stopping time (t [s]) for different mass percentages (m=100%, m=66%, m=33%).
8 IRB 1520

8.1 IRB 1520ID 1.5 m 4 kg

Category 0

The following table describes the stopping distance and time for category 0 emergency stop at max speed, with the arm stretched out to the maximum with maximum load. All results are from tests on one moving axis.

<table>
<thead>
<tr>
<th>Axis</th>
<th>Distance (degrees)</th>
<th>Stop time (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>20.2</td>
<td>0.22</td>
</tr>
<tr>
<td>2</td>
<td>18.5</td>
<td>0.17</td>
</tr>
<tr>
<td>3</td>
<td>15.0</td>
<td>0.12</td>
</tr>
</tbody>
</table>

Category 1, extension zones

For definitions of the zones, see Extension zones for articulated robots on page 14.

<table>
<thead>
<tr>
<th>Zone</th>
<th>wcp min (m)</th>
<th>wcp max (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0.5</td>
</tr>
<tr>
<td>1</td>
<td>0.5</td>
<td>1.0</td>
</tr>
<tr>
<td>2</td>
<td>1.0</td>
<td>max reach</td>
</tr>
</tbody>
</table>

Category 1, Axis 1

Extension zone 0, stopping distance and stopping time

Continues on next page
Extension zone 1, stopping distance and stopping time

Continued
Extension zone 2, stopping distance and stopping time

![Graph showing stopping distance and stopping time for different mass ratios (m=100%, m=66%, m=33%) against velocity (v [m/s]).]
Category 1, Axis 2

Extension zone 0, stopping distance and stopping time
Extension zone 1, stopping distance and stopping time

![Diagram showing stopping distance and time vs. velocity for different mass loads (m=100%, m=66%, m=33%) for IRB 1520ID 1.5 m 4 kg.](image)

Continued
Extension zone 2, stopping distance and stopping time

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Continues on next page
Category 1, Axis 3

Extension zone 0, stopping distance and stopping time

---

Continues on next page
Extension zone 1, stopping distance and stopping time

![Graph showing stopping distance and time vs. velocity for different loads (m=100%, m=66%, m=33%).]
Extension zone 2, stopping distance and stopping time

- Top graph: Plot of $\phi_i$ vs. $v$ for different values of $m$ (100%, 66%, 33%).
- Bottom graph: Plot of $t$ vs. $v$ for different values of $m$ (100%, 66%, 33%).
9 IRB 1600

9.1 IRB 1600 1.2 m 6 kg

Category 0

The following table describes the stopping distance and time for category 0 emergency stop at max speed, with the arm stretched out to the maximum with maximum load. All results are from tests on one moving axis.

<table>
<thead>
<tr>
<th>Axis</th>
<th>Distance (degrees)</th>
<th>Stop time (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>19.7</td>
<td>0.17</td>
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<tr>
<td>2</td>
<td>16.8</td>
<td>0.12</td>
</tr>
<tr>
<td>3</td>
<td>16.1</td>
<td>0.1</td>
</tr>
</tbody>
</table>

Category 1, extension zones

For definitions of the zones, see *Extension zones for articulated robots on page 14*.

<table>
<thead>
<tr>
<th>Zone</th>
<th>wcp min (m)</th>
<th>wcp max (m)</th>
</tr>
</thead>
<tbody>
<tr>
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<td>0</td>
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</tr>
<tr>
<td>1</td>
<td>0.408</td>
<td>0.817</td>
</tr>
<tr>
<td>2</td>
<td>0.817</td>
<td>max reach</td>
</tr>
</tbody>
</table>

Category 1, Axis 1

Extension zone 0, stopping distance and stopping time

Continues on next page
Extension zone 1, stopping distance and stopping time

Continued
Extension zone 2, stopping distance and stopping time

![Graph of stopping distance and time vs speed]

Continued
Category 1, Axis 2

Extension zone 0, stopping distance and stopping time

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Continues on next page
Extension zone 1, stopping distance and stopping time

![Graph showing stopping distance and time vs. velocity]

Continues on next page
Extension zone 2, stopping distance and stopping time

![Graphs showing stopping distances and times for IRB 1600](image-url)

- **v [m/s]** vs. **Δθ [°]**
- **v [m/s]** vs. **t [s]**

Key:
- Red line: m=100%
- Green line: m=66%
- Blue line: m=33%
Category 1, Axis 3

Extension zone 0, stopping distance and stopping time
Extension zone 1, stopping distance and stopping time

![Graphs showing stopping distance and time for different mass loads](image)
Extension zone 2, stopping distance and stopping time

![Graphs of stopping distance and stopping time for different mass percentages (m=100%, m=66%, m=33%) with velocity (v) on the x-axis and stopping distance (Pf) and stopping time (t) on the y-axis.]
9.2 IRB 1600 1.2 m 10 kg

The following table describes the stopping distance and time for category 0 emergency stop at max speed, with the arm stretched out to the maximum with maximum load. All results are from tests on one moving axis.

<table>
<thead>
<tr>
<th>Axis</th>
<th>Distance (degrees)</th>
<th>Stop time (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>22.7</td>
<td>0.17</td>
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<tr>
<td>2</td>
<td>26.1</td>
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<td>3</td>
<td>22.3</td>
<td>0.15</td>
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</table>

Category 1, extension zones

For definitions of the zones, see Extension zones for articulated robots on page 14.

<table>
<thead>
<tr>
<th>Zone</th>
<th>wcp min (m)</th>
<th>wcp max (m)</th>
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</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0.408</td>
</tr>
<tr>
<td>1</td>
<td>0.408</td>
<td>0.817</td>
</tr>
<tr>
<td>2</td>
<td>0.817</td>
<td>max reach</td>
</tr>
</tbody>
</table>

Category 1, Axis 1

Extension zone 0, stopping distance and stopping time
Extension zone 1, stopping distance and stopping time

Continues on next page
9 IRB 1600

9.2 IRB 1600 1.2 m 10 kg

Continued

Extension zone 2, stopping distance and stopping time

![Graphs showing stopping distance and time for different velocities.](image)
Category 1, Axis 2
Extension zone 0, stopping distance and stopping time

---

![Graph 1](image1)

![Graph 2](image2)

Continues on next page
Extension zone 1, stopping distance and stopping time

![Graph showing stopping distance and time](image)

Continues on next page
Extension zone 2, stopping distance and stopping time

![Graph 1: ](image1.png)

![Graph 2: ](image2.png)
9 IRB 1600

9.2 IRB 1600 1.2 m 10 kg

Continued

Category 1, Axis 3

Extension zone 0, stopping distance and stopping time

![Graphs showing stopping distance and time for different masses](image)

Continues on next page
Extension zone 1, stopping distance and stopping time

![Graph showing stopping distance vs. velocity](image)

![Graph showing stopping time vs. velocity](image)
Extension zone 2, stopping distance and stopping time
9.3 IRB 1600 1.45 m 6 kg

Category 0

The following table describes the stopping distance and time for category 0 emergency stop at max speed, with the arm stretched out to the maximum with maximum load. All results are from tests on one moving axis.

<table>
<thead>
<tr>
<th>Axis</th>
<th>Distance (degrees)</th>
<th>Stop time (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>23.4</td>
<td>0.2</td>
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<tr>
<td>2</td>
<td>22.0</td>
<td>0.17</td>
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<tr>
<td>3</td>
<td>15.8</td>
<td>0.1</td>
</tr>
</tbody>
</table>

Category 1, extension zones

For definitions of the zones, see Extension zones for articulated robots on page 14.

<table>
<thead>
<tr>
<th>Zone</th>
<th>wcp min (m)</th>
<th>wcp max (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0.483</td>
</tr>
<tr>
<td>1</td>
<td>0.483</td>
<td>0.967</td>
</tr>
<tr>
<td>2</td>
<td>0.967</td>
<td>max reach</td>
</tr>
</tbody>
</table>

Category 1, Axis 1

Extension zone 0, stopping distance and stopping time
9 IRB 1600

9.3 IRB 1600 1.45 m 6 kg

Continued

Extension zone 1, stopping distance and stopping time
Extension zone 2, stopping distance and stopping time

![Graph showing stopping distance and time vs. velocity]

Continues on next page
Category 1, Axis 2

Extension zone 0, stopping distance and stopping time

![Graph 1](image1)

![Graph 2](image2)
Extension zone 1, stopping distance and stopping time

![Graph 1](image1)

![Graph 2](image2)
Extension zone 2, stopping distance and stopping time

![Graph 1](image1)

![Graph 2](image2)
Category 1, Axis 3

Extension zone 0, stopping distance and stopping time

![Graph showing stopping distances and times for different masses and velocities.](image)

Continued
Extension zone 1, stopping distance and stopping time

![Graph showing stopping distances and times for IRB 1600](image)

- **Ph [°]**
  - m=100%
  - m=66%
  - m=33%

- **t [s]**
  - m=100%
  - m=66%
  - m=33%

9.3 IRB 1600 1.45 m 6 kg

Continues
Extension zone 2, stopping distance and stopping time

![Graph 1: Phi vs. v for m=100%, m=66%, m=33%]

![Graph 2: t vs. v for m=100%, m=66%, m=33%]
Category 0

The following table describes the stopping distance and time for category 0 emergency stop at max speed, with the arm stretched out to the maximum with maximum load. All results are from tests on one moving axis.

<table>
<thead>
<tr>
<th>Axis</th>
<th>Distance (degrees)</th>
<th>Stop time (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>27.9</td>
<td>0.22</td>
</tr>
<tr>
<td>2</td>
<td>30.9</td>
<td>0.25</td>
</tr>
<tr>
<td>3</td>
<td>22.3</td>
<td>0.15</td>
</tr>
</tbody>
</table>

Category 1, extension zones

For definitions of the zones, see Extension zones for articulated robots on page 14.

<table>
<thead>
<tr>
<th>Zone</th>
<th>wcp min (m)</th>
<th>wcp max (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0.483</td>
</tr>
<tr>
<td>1</td>
<td>0.483</td>
<td>0.967</td>
</tr>
<tr>
<td>2</td>
<td>0.967</td>
<td>max reach</td>
</tr>
</tbody>
</table>

Category 1, Axis 1

Extension zone 0, stopping distance and stopping time

[Graph showing stopping distance and time for category 1, Axis 1]
Extension zone 1, stopping distance and stopping time

Continues on next page
Extension zone 2, stopping distance and stopping time
Category 1, Axis 2

Extension zone 0, stopping distance and stopping time

![Graph showing stopping distance and stopping time for different values of m (100%, 66%, 33%) for various speeds (v) in m/s.](image)

Continues on next page
Extension zone 1, stopping distance and stopping time
Extension zone 2, stopping distance and stopping time

![Graph 1: Pha vs. v (m/s)](image)

- Red line: m=100%
- Green line: m=66%
- Blue line: m=33%

![Graph 2: t vs. v (m/s)](image)

- Red line: m=100%
- Green line: m=66%
- Blue line: m=33%

Continues on next page
Category 1, Axis 3

Extension zone 0, stopping distance and stopping time

![Graph showing stopping distance and time as a function of velocity](image)

Continues on next page
Extension zone 1, stopping distance and stopping time

![Graph 1](image1)

![Graph 2](image2)
Extension zone 2, stopping distance and stopping time

![Graph showing stopping distance and stopping time for IRB 1600 robot.](image)
The following table describes the stopping distance and time for category 0 emergency stop at max speed, with the arm stretched out to the maximum with maximum load. All results are from tests on one moving axis.

<table>
<thead>
<tr>
<th>Axis</th>
<th>Distance (degrees)</th>
<th>Stop time (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>32.2</td>
<td>0.25</td>
</tr>
<tr>
<td>2</td>
<td>29.1</td>
<td>0.22</td>
</tr>
<tr>
<td>3</td>
<td>21.5</td>
<td>0.15</td>
</tr>
</tbody>
</table>

Category 1, extension zones

For definitions of the zones, see Extension zones for articulated robots on page 14.

<table>
<thead>
<tr>
<th>Zone</th>
<th>wcp min (m)</th>
<th>wcp max (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0.5</td>
</tr>
<tr>
<td>1</td>
<td>0.5</td>
<td>1.0</td>
</tr>
<tr>
<td>2</td>
<td>1.0</td>
<td>max reach</td>
</tr>
</tbody>
</table>

Category 1, Axis 1

Extension zone 0, stopping distance and stopping time
Extension zone 1, stopping distance and stopping time

Continues on next page
Extension zone 2, stopping distance and stopping time

![Graph showing stopping distance and time versus speed](image)

- **Graph 1:** Distance (d) vs. Speed (v) for different masses (m=100%, m=66%, m=33%)
- **Graph 2:** Time (t) vs. Speed (v) for different masses (m=100%, m=66%, m=33%)
Category 1, Axis 2

Extension zone 0, stopping distance and stopping time

[Graphs showing stopping distances and times for different mass percentages (m=100%, m=66%, m=33%)]
Extension zone 1, stopping distance and stopping time

\[ P(t) \text{ [m]} \]

\[ t \text{ [s]} \]

\[ m=100\% \]
\[ m=66\% \]
\[ m=33\% \]
Extension zone 2, stopping distance and stopping time

![Graph showing stopping distance and time for different masses](image)

Continued
Category 1, Axis 3

Extension zone 0, stopping distance and stopping time

![Graph showing stopping distance and time as functions of velocity for different mass percentages.](image-url)
Extension zone 1, stopping distance and stopping time

![Graph showing stopping distance and time for different masses (m) against velocity (v).]
Extension zone 2, stopping distance and stopping time

![Graph 1: Plot of $P_i$ vs. $v$ for different mass ratios (m=100%, m=66%, m=33%).](image1)

![Graph 2: Plot of $t$ vs. $v$ for different mass ratios (m=100%, m=66%, m=33%).](image2)
This page is intentionally left blank
10 IRB 1660

10.1 IRB 1660ID 1.55 m 4 kg

Category 0

The following table describes the stopping distance and time for category 0 emergency stop at max speed, with the arm stretched out to the maximum with maximum load. All results are from tests on one moving axis.

<table>
<thead>
<tr>
<th>Axis</th>
<th>Distance (degrees)</th>
<th>Stop time (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>29.6</td>
<td>0.22</td>
</tr>
<tr>
<td>2</td>
<td>40.2</td>
<td>0.34</td>
</tr>
<tr>
<td>3</td>
<td>26.8</td>
<td>0.2</td>
</tr>
</tbody>
</table>

Category 1, extension zones

For definitions of the zones, see Extension zones for articulated robots on page 14.

<table>
<thead>
<tr>
<th>Zone</th>
<th>wcp min (m)</th>
<th>wcp max (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0.0</td>
</tr>
<tr>
<td>1</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>2</td>
<td>0.0</td>
<td>max reach</td>
</tr>
</tbody>
</table>

Category 1, Axis 1

Extension zone 0, stopping distance and stopping time

![Graph showing stopping distance and time](image)

Continues on next page
Extension zone 1, stopping distance and stopping time
Extension zone 2, stopping distance and stopping time

**Graph 1:**
- **y-axis:** $P_h$ [°]
- **x-axis:** $v$ [m/s]
- Lines for $m=100\%$, $m=66\%$, $m=33\%$

**Graph 2:**
- **y-axis:** $t$ [s]
- **x-axis:** $v$ [m/s]
- Lines for $m=100\%$, $m=66\%$, $m=33\%$
Category 1, Axis 2

Extension zone 0, stopping distance and stopping time

![Graph 1](image1)

![Graph 2](image2)
Extension zone 1, stopping distance and stopping time

![Graph of stopping distance and time vs. velocity](image)

Continued
Extension zone 2, stopping distance and stopping time

![Graph showing stopping distance and time for different mass ratios (m=100%, m=66%, m=33%) as a function of velocity (v) in meters per second (m/s)].

Continues on next page
Category 1, Axis 3

Extension zone 0, stopping distance and stopping time

---

Continued
Extension zone 1, stopping distance and stopping time

![Graphs showing stopping distance and time for different masses and speeds.](image-url)
Extension zone 2, stopping distance and stopping time
10.2 IRB 1660ID 1.55 m 6 kg

Category 0

The following table describes the stopping distance and time for category 0 emergency stop at max speed, with the arm stretched out to the maximum with maximum load. All results are from tests on one moving axis.

<table>
<thead>
<tr>
<th>Axis</th>
<th>Distance (degrees)</th>
<th>Stop time (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>29.5</td>
<td>0.22</td>
</tr>
<tr>
<td>2</td>
<td>39.5</td>
<td>0.32</td>
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<tr>
<td>3</td>
<td>26.6</td>
<td>0.2</td>
</tr>
</tbody>
</table>

Category 1, extension zones

For definitions of the zones, see Extension zones for articulated robots on page 14.

<table>
<thead>
<tr>
<th>Zone</th>
<th>wcp min (m)</th>
<th>wcp max (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0.0</td>
</tr>
<tr>
<td>1</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>2</td>
<td>0.0</td>
<td>max reach</td>
</tr>
</tbody>
</table>

Category 1, Axis 1

Extension zone 0, stopping distance and stopping time
Extension zone 1, stopping distance and stopping time

Continues on next page
Extension zone 2, stopping distance and stopping time
Category 1, Axis 2
Extension zone 0, stopping distance and stopping time

Continues on next page
Extension zone 1, stopping distance and stopping time

---

Continued
Extension zone 2, stopping distance and stopping time

![Graph showing stopping distance and time vs. speed for different mass percentages.](image)

Continues on next page
Category 1, Axis 3

Extension zone 0, stopping distance and stopping time

![Graphs showing stopping distance and time vs. velocity for different masses (m=100%, m=66%, m=33%).]
Extension zone 1, stopping distance and stopping time

![Graph showing stopping distance and stopping time](image)
Extension zone 2, stopping distance and stopping time

![Graph showing stopping distance and time versus velocity](image)

- Ph [°]
- t [s]
- v [m/s]

Legend:
- m=100%
- m=66%
- m=33%
11 IRB 2400

11.1 IRB 2400 1.5 m 10 kg

Category 0

The following table describes the stopping distance and time for category 0 emergency stop at max speed, with the arm stretched out to the maximum with maximum load. All results are from tests on one moving axis.

<table>
<thead>
<tr>
<th>Axis</th>
<th>Distance (degrees)</th>
<th>Stop time (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>46.9</td>
<td>0.51</td>
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<td>2</td>
<td>36.4</td>
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<tr>
<td>3</td>
<td>22.8</td>
<td>0.2</td>
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</tbody>
</table>

Category 1, extension zones

For definitions of the zones, see Extension zones for articulated robots on page 14.

<table>
<thead>
<tr>
<th>Zone</th>
<th>wcp min (m)</th>
<th>wcp max (m)</th>
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<tr>
<td>1</td>
<td>0.524</td>
<td>1.048</td>
</tr>
<tr>
<td>2</td>
<td>1.048</td>
<td>max reach</td>
</tr>
</tbody>
</table>

Category 1, Axis 1

Extension zone 0, stopping distance and stopping time

Continues on next page
Extension zone 1, stopping distance and stopping time

Continues on next page
Extension zone 2, stopping distance and stopping time
11 IRB 2400

11.1 IRB 2400 1.5 m 10 kg

Continued

Category 1, Axis 2

Extension zone 0, stopping distance and stopping time

---

Continues on next page
Extension zone 1, stopping distance and stopping time

Continued
Extension zone 2, stopping distance and stopping time

![Graph 1: \( \Phi_i \) vs. \( v \) for different masses (m=100%, m=66%, m=33%)]

![Graph 2: \( t \) vs. \( v \) for different masses (m=100%, m=66%, m=33%)]
Category 1, Axis 3

Extension zone 0, stopping distance and stopping time

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Continues on next page
Extension zone 1, stopping distance and stopping time

![Graph showing stopping distance and time vs. velocity for different mass percentages]

Continues on next page
Extension zone 2, stopping distance and stopping time

![Graph showing stopping distance and time vs. velocity](image-url)
Category 0

The following table describes the stopping distance and time for category 0 emergency stop at max speed, with the arm stretched out to the maximum with maximum load. All results are from tests on one moving axis.

<table>
<thead>
<tr>
<th>Axis</th>
<th>Distance (degrees)</th>
<th>Stop time (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>53.2</td>
<td>0.61</td>
</tr>
<tr>
<td>2</td>
<td>36.1</td>
<td>0.32</td>
</tr>
<tr>
<td>3</td>
<td>29.1</td>
<td>0.27</td>
</tr>
</tbody>
</table>

Category 1, extension zones

For definitions of the zones, see Extension zones for articulated robots on page 14.

<table>
<thead>
<tr>
<th>Zone</th>
<th>wcp min (m)</th>
<th>wcp max (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0.524</td>
</tr>
<tr>
<td>1</td>
<td>0.524</td>
<td>1.048</td>
</tr>
<tr>
<td>2</td>
<td>1.048</td>
<td>max reach</td>
</tr>
</tbody>
</table>

Category 1, Axis 1

Extension zone 0, stopping distance and stopping time
Extension zone 1, stopping distance and stopping time

Continues on next page
Extension zone 2, stopping distance and stopping time

![Graphs showing stopping distance and stopping time for different masses]

Continues on next page
Category 1, Axis 2

Extension zone 0, stopping distance and stopping time
Extension zone 1, stopping distance and stopping time

![Graph showing stopping distance and time vs. velocity.](image-url)
Extension zone 2, stopping distance and stopping time

![Graph 1: Plot of $P_{hi}$ vs. $v$]

![Graph 2: Plot of $t$ vs. $v$]

$P_{hi}$ [°C]

$m=100\%$
$m=66\%$
$m=33\%$

$t$ [s]

$v$ [m/s]
Category 1, Axis 3

Extension zone 0, stopping distance and stopping time
Extension zone 1, stopping distance and stopping time
11 IRB 2400

11.2 IRB 2400 1.5 m 16 kg

Continued

Extension zone 2, stopping distance and stopping time

![Graph showing stopping distance and time vs. speed](image)

**Continued**
12 IRB 2600

12.1 IRB 2600 1.65 m 12 kg

Category 0

The following table describes the stopping distance and time for category 0 emergency stop at max speed, with the arm stretched out to the maximum with maximum load. All results are from tests on one moving axis.

<table>
<thead>
<tr>
<th>Axis</th>
<th>Distance (degrees)</th>
<th>Stop time (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>26.6</td>
<td>0.2</td>
</tr>
<tr>
<td>2</td>
<td>26.9</td>
<td>0.2</td>
</tr>
<tr>
<td>3</td>
<td>18.2</td>
<td>0.12</td>
</tr>
</tbody>
</table>

Category 1, extension zones

For definitions of the zones, see *Extension zones for articulated robots on page 14.*

<table>
<thead>
<tr>
<th>Zone</th>
<th>wcp min (m)</th>
<th>wcp max (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0.0</td>
</tr>
<tr>
<td>1</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>2</td>
<td>0.0</td>
<td>max reach</td>
</tr>
</tbody>
</table>

Category 1, Axis 1

Extension zone 0, stopping distance and stopping time

![Graph showing stopping distance and time](image-url)
12 IRB 2600

12.1 IRB 2600 1.65 m 12 kg

Continued

Extension zone 1, stopping distance and stopping time

Continues on next page
Extension zone 2, stopping distance and stopping time

![Graph showing stopping distance and time for different mass conditions](image)

*Continued on next page*
Category 1, Axis 2

Extension zone 0, stopping distance and stopping time

![Graph 1: \( \Phi \) vs. \( v \)](image1)

![Graph 2: \( t \) vs. \( v \)](image2)
Extension zone 1, stopping distance and stopping time

![Graph showing stopping distance and time against speed for different mass loads (m=100%, m=66%, m=33%)](image_url)
Extension zone 2, stopping distance and stopping time
Category 1, Axis 3

Extension zone 0, stopping distance and stopping time

![Graph 1: Stopping Distance (\(\Phi_s\)) vs. Velocity (v)]

- \(\Phi_s\) vs. \(v\)
- Lines represent different mass percentages:
  - \(m = 100\%\)
  - \(m = 66\%\)
  - \(m = 33\%\)

![Graph 2: Stopping Time (t) vs. Velocity (v)]

- \(t\) vs. \(v\)
- Lines represent different mass percentages:
  - \(m = 100\%\)
  - \(m = 66\%\)
  - \(m = 33\%\)
Extension zone 1, stopping distance and stopping time

[Graphs showing stopping distance and time as functions of velocity for different masses (m=100%, m=66%, m=33%).]

Continued
Extension zone 2, stopping distance and stopping time

![Graphs showing stopping distance and time vs. velocity for different mass ratios.

- Graph on the top shows $P_h$ [°] vs. $v$ [m/s] with lines for $m=100\%$, $m=66\%$, and $m=33\%$.
- Graph on the bottom shows $t$ [s] vs. $v$ [m/s] with similar lines for the mass ratios.

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The following table describes the stopping distance and time for category 0 emergency stop at max speed, with the arm stretched out to the maximum with maximum load. All results are from tests on one moving axis.

<table>
<thead>
<tr>
<th>Axis</th>
<th>Distance (degrees)</th>
<th>Stop time (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>28.7</td>
<td>0.22</td>
</tr>
<tr>
<td>2</td>
<td>30.5</td>
<td>0.25</td>
</tr>
<tr>
<td>3</td>
<td>22.4</td>
<td>0.17</td>
</tr>
</tbody>
</table>

Category 1, extension zones

For definitions of the zones, see Extension zones for articulated robots on page 14.

<table>
<thead>
<tr>
<th>Zone</th>
<th>wcp min (m)</th>
<th>wcp max (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0.01</td>
</tr>
<tr>
<td>1</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>2</td>
<td>0.0</td>
<td>max reach</td>
</tr>
</tbody>
</table>

Category 1, Axis 1

Extension zone 0, stopping distance and stopping time
Extension zone 1, stopping distance and stopping time

```
Continues on next page
```
Extension zone 2, stopping distance and stopping time

![Graph showing stopping distance and time vs. velocity for different mass percentages (m=100%, m=66%, m=33%).]
Category 1, Axis 2

Extension zone 0, stopping distance and stopping time

[Graphs showing stopping distance and time for different speeds and masses]
Extension zone 1, stopping distance and stopping time

![Graph showing stopping distance and time vs. velocity for different masses (m=100%, m=66%, m=33%).]
Extension zone 2, stopping distance and stopping time

![Graph 1: $P_h$ vs. $v$](image1)

![Graph 2: $t$ vs. $v$](image2)

Continued
Category 1, Axis 3

Extension zone 0, stopping distance and stopping time
Extension zone 1, stopping distance and stopping time

\[ P_1 [\text{m}] \]
\[ \text{v [m/s]} \]

\[ t [\text{s}] \]
\[ \text{v [m/s]} \]

$m=100\%$
$m=66\%$
$m=33\%$
Extension zone 2, stopping distance and stopping time

![Graphs showing stopping distance and stopping time for IRB 2600](image-url)
12.3 IRB 2600 1.85 m 12 kg

Category 0

The following table describes the stopping distance and time for category 0 emergency stop at max speed, with the arm stretched out to the maximum with maximum load. All results are from tests on one moving axis.

<table>
<thead>
<tr>
<th>Axis</th>
<th>Distance (degrees)</th>
<th>Stop time (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>30.3</td>
<td>0.25</td>
</tr>
<tr>
<td>2</td>
<td>30.9</td>
<td>0.25</td>
</tr>
<tr>
<td>3</td>
<td>17.8</td>
<td>0.12</td>
</tr>
</tbody>
</table>

Category 1, extension zones

For definitions of the zones, see Extension zones for articulated robots on page 14.

<table>
<thead>
<tr>
<th>Zone</th>
<th>wcp min (m)</th>
<th>wcp max (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0.0</td>
</tr>
<tr>
<td>1</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>2</td>
<td>0.0</td>
<td>max reach</td>
</tr>
</tbody>
</table>

Category 1, Axis 1

Extension zone 0, stopping distance and stopping time

Continues on next page
Extension zone 1, stopping distance and stopping time
Extension zone 2, stopping distance and stopping time

![Graphs showing stopping distances and times for different mass loads (m) and velocities (v)].
Category 1, Axis 2

Extension zone 0, stopping distance and stopping time

![Graph of stopping distance and time for different loads](image)

<table>
<thead>
<tr>
<th>Load</th>
<th>Stopping Distance</th>
<th>Stopping Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>100%</td>
<td>25 m</td>
<td>0.15 s</td>
</tr>
<tr>
<td>66%</td>
<td>23 m</td>
<td>0.13 s</td>
</tr>
<tr>
<td>33%</td>
<td>20.5 m</td>
<td>0.11 s</td>
</tr>
</tbody>
</table>

Continues on next page
Extension zone 1, stopping distance and stopping time

![Graph showing stopping distance and time vs. velocity for different load factors (m = 100%, m = 66%, m = 33%).]
Extension zone 2, stopping distance and stopping time

![Graphs showing stopping distances and times for different percentages of mass (m) and velocities (v)]
Category 1, Axis 3

Extension zone 0, stopping distance and stopping time

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Continues on next page
Extension zone 1, stopping distance and stopping time

![Graphs showing stopping distance and time vs speed for different mass fractions m = 100%, m = 66%, and m = 33%]
Extension zone 2, stopping distance and stopping time

![Graph showing stopping distance and time as a function of velocity for different mass loadings.](image)
The following table describes the stopping distance and time for category 0 emergency stop at max speed, with the arm stretched out to the maximum with maximum load. All results are from tests on one moving axis.

<table>
<thead>
<tr>
<th>Axis</th>
<th>Distance (degrees)</th>
<th>Stop time (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>33.1</td>
<td>0.27</td>
</tr>
<tr>
<td>2</td>
<td>34.4</td>
<td>0.27</td>
</tr>
<tr>
<td>3</td>
<td>20.7</td>
<td>0.15</td>
</tr>
</tbody>
</table>

Category 1, extension zones

For definitions of the zones, see Extension zones for articulated robots on page 14.

<table>
<thead>
<tr>
<th>Zone</th>
<th>wcp min (m)</th>
<th>wcp max (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0.617</td>
</tr>
<tr>
<td>1</td>
<td>0.617</td>
<td>1.233</td>
</tr>
<tr>
<td>2</td>
<td>1.233</td>
<td>max reach</td>
</tr>
</tbody>
</table>

Category 1, Axis 1

Extension zone 0, stopping distance and stopping time
Extension zone 1, stopping distance and stopping time

Continued...
Extension zone 2, stopping distance and stopping time

Graphs showing stopping distance and time for different masses.
Category 1, Axis 2

Extension zone 0, stopping distance and stopping time

![Graphs showing stopping distance and time vs. velocity for different mass values](image-url)

Continues on next page
Extension zone 1, stopping distance and stopping time

![Graph showing stopping distance and time vs. velocity](image)

Continues on next page
Extension zone 2, stopping distance and stopping time

```plaintext
\begin{figure}
\centering
\begin{subfigure}{\textwidth}
\includegraphics[width=\textwidth]{graph1}
\end{subfigure}
\begin{subfigure}{\textwidth}
\includegraphics[width=\textwidth]{graph2}
\end{subfigure}
\caption{Graphs showing stopping distance and time for different speeds and load factors.}
\end{figure}
```
Category 1, Axis 3

Extension zone 0, stopping distance and stopping time
Extension zone 1, stopping distance and stopping time

![Graph showing stopping distance and stopping time](image)

Continued
Extension zone 2, stopping distance and stopping time

![Graph showing stopping distance and time vs. velocity for different masses]

- Upper graph: θ (in °C) vs. v (in m/s) for m=100%, m=66%, m=33%
- Lower graph: t (in s) vs. v (in m/s) for m=100%, m=66%, m=33%
12.5 IRB 2600ID 2.00 m 8 kg

Category 0

The following table describes the stopping distance and time for category 0 emergency stop at max speed, with the arm stretched out to the maximum with maximum load. All results are from tests on one moving axis.

<table>
<thead>
<tr>
<th>Axis</th>
<th>Distance (degrees)</th>
<th>Stop time (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>31.8</td>
<td>0.27</td>
</tr>
<tr>
<td>2</td>
<td>33.7</td>
<td>0.29</td>
</tr>
<tr>
<td>3</td>
<td>23.0</td>
<td>0.17</td>
</tr>
</tbody>
</table>

Category 1, extension zones

For definitions of the zones, see Extension zones for articulated robots on page 14.

<table>
<thead>
<tr>
<th>Zone</th>
<th>wcp min (m)</th>
<th>wcp max (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0.667</td>
</tr>
<tr>
<td>1</td>
<td>0.667</td>
<td>1.333</td>
</tr>
<tr>
<td>2</td>
<td>1.333</td>
<td>max reach</td>
</tr>
</tbody>
</table>

Category 1, Axis 1

Extension zone 0, stopping distance and stopping time

Continues on next page
Extension zone 1, stopping distance and stopping time

Continues on next page
Extension zone 2, stopping distance and stopping time

![Graphs showing stopping distance and time vs. velocity for different mass levels.](image)
Category 1, Axis 2

Extension zone 0, stopping distance and stopping time

![Graph showing stopping distance and stopping time for different mass percentages.](image)
Extension zone 1, stopping distance and stopping time

Continues on next page
Extension zone 2, stopping distance and stopping time

![Graph showing stopping distance and time vs. velocity]

Continued
Category 1, Axis 3

Extension zone 0, stopping distance and stopping time

---

Continued
Extension zone 1, stopping distance and stopping time

Graphs showing the relationship between velocity (v [m/s]) and the stopping distance (P [m]) and stopping time (t [s]) for different percentages of mass (m=100%, m=66%, m=33%).
Extension zone 2, stopping distance and stopping time

Graph 1: $P_h$ vs. $v$

Graph 2: $t$ vs. $v$
This page is intentionally left blank
13 IRB 4400

13.1 IRB 4400 1.95 m 45 kg

Category 0

The following table describes the stopping distance and time for category 0 emergency stop at max speed, with the arm stretched out to the maximum with maximum load. All results are from tests on one moving axis.

<table>
<thead>
<tr>
<th>Axis</th>
<th>Distance (degrees)</th>
<th>Stop time (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>67.8</td>
<td>0.8</td>
</tr>
<tr>
<td>2</td>
<td>18.8</td>
<td>0.22</td>
</tr>
<tr>
<td>3</td>
<td>18.2</td>
<td>0.22</td>
</tr>
</tbody>
</table>

Category 1, extension zones

For definitions of the zones, see Extension zones for articulated robots on page 14.

<table>
<thead>
<tr>
<th>Zone</th>
<th>wcp min (m)</th>
<th>wcp max (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0.661</td>
</tr>
<tr>
<td>1</td>
<td>0.661</td>
<td>1.322</td>
</tr>
<tr>
<td>2</td>
<td>1.322</td>
<td>max reach</td>
</tr>
</tbody>
</table>

Category 1, Axis 1

Extension zone 0, stopping distance and stopping time

Continues on next page
Extension zone 1, stopping distance and stopping time
Extension zone 2, stopping distance and stopping time

\[ P_h [\, ^\circ] \]

\[ t [\, s] \]

\[ v [\, m/s] \]

- \( m=100\% \)
- \( m=66\% \)
- \( m=33\% \)

Continued
Category 1, Axis 2

Extension zone 0, stopping distance and stopping time

Continued
Extension zone 1, stopping distance and stopping time

![Graph showing stopping distance and time for different masses]

Continued
Extension zone 2, stopping distance and stopping time

![Graphs showing stopping distance and time for different mass ratios (m=100%, m=66%, m=33%) vs. velocity (v) in m/s.](image-url)
Category 1, Axis 3

Extension zone 0, stopping distance and stopping time

---

Continued
Extension zone 1, stopping distance and stopping time
Extension zone 2, stopping distance and stopping time

![Graph showing stopping distance and time vs velocity]

- Graph 1: $P_h \degree C$ vs $v \text{ m/s}$
  - Red line: $m=100\%$
  - Green line: $m=66\%$
  - Blue line: $m=33\%$

- Graph 2: $t \text{ s}$ vs $v \text{ m/s}$
  - Red line: $m=100\%$
  - Green line: $m=66\%$
  - Blue line: $m=33\%$
13.2 IRB 4400

The following table describes the stopping distance and time for category 0 emergency stop at max speed, with the arm stretched out to the maximum with maximum load. All results are from tests on one moving axis.

<table>
<thead>
<tr>
<th>Axis</th>
<th>Distance (degrees)</th>
<th>Stop time (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>75.1</td>
<td>0.9</td>
</tr>
<tr>
<td>2</td>
<td>20.2</td>
<td>0.25</td>
</tr>
<tr>
<td>3</td>
<td>20.6</td>
<td>0.27</td>
</tr>
</tbody>
</table>

Category 1, extension zones

For definitions of the zones, see Extension zones for articulated robots on page 14.

<table>
<thead>
<tr>
<th>Zone</th>
<th>wcp min (m)</th>
<th>wcp max (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0.661</td>
</tr>
<tr>
<td>1</td>
<td>0.661</td>
<td>1.322</td>
</tr>
<tr>
<td>2</td>
<td>1.322</td>
<td>max reach</td>
</tr>
</tbody>
</table>

Category 1, Axis 1

Extension zone 0, stopping distance and stopping time
Extension zone 1, stopping distance and stopping time
Extension zone 2, stopping distance and stopping time

![Graphs showing stopping distance and time for different speeds and masses.](image-url)
Category 1, Axis 2

Extension zone 0, stopping distance and stopping time

![Graph showing stopping distance and time for different masses](image)

Continues on next page
Extension zone 1, stopping distance and stopping time

![Graph showing stopping distance and time for different masses (m=100%, m=66%, m=33%) vs. velocity (v)]
Extension zone 2, stopping distance and stopping time

![Graph showing stopping distance and time for different speeds and load percentages.](image)

Continues on next page
Category 1, Axis 3

Extension zone 0, stopping distance and stopping time

---

Continues on next page
Extension zone 1, stopping distance and stopping time

![Graph showing stopping distance and stopping time vs. velocity for different mass loads.]

Continued
13.2 IRB 4400 1.95 m 60 kg

*Continued*

Extension zone 2, stopping distance and stopping time

![Graphs showing stopping distance and time vs. speed](image-url)
13.3 IRB 4400 2.6 m 10 kg

Category 0

The following table describes the stopping distance and time for category 0 emergency stop at max speed, with the arm stretched out to the maximum with maximum load. All results are from tests on one moving axis.

<table>
<thead>
<tr>
<th>Axis</th>
<th>Distance (degrees)</th>
<th>Stop time (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>51.3</td>
<td>0.58</td>
</tr>
<tr>
<td>2</td>
<td>21.1</td>
<td>0.2</td>
</tr>
<tr>
<td>3</td>
<td>19.0</td>
<td>0.17</td>
</tr>
</tbody>
</table>

Category 1, extension zones

For definitions of the zones, see Extension zones for articulated robots on page 14.

<table>
<thead>
<tr>
<th>Zone</th>
<th>wcp min (m)</th>
<th>wcp max (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0.0</td>
</tr>
<tr>
<td>1</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>2</td>
<td>0.0</td>
<td>max reach</td>
</tr>
</tbody>
</table>

Category 1, Axis 1

Extension zone 0, stopping distance and stopping time

Continues on next page
Extension zone 1, stopping distance and stopping time

Continued
Extension zone 2, stopping distance and stopping time

![Graph showing stopping distance and time vs. velocity](image)

*Continued on next page*
Category 1, Axis 2

Extension zone 0, stopping distance and stopping time
Extension zone 1, stopping distance and stopping time

![Graph showing stopping distance and stopping time vs velocity, with three different mass scenarios: m=100%, m=66%, m=33%.

Continued on next page.
Extension zone 2, stopping distance and stopping time
Category 1, Axis 3

Extension zone 0, stopping distance and stopping time
Extension zone 1, stopping distance and stopping time

\[ P_h \text{[\textdegree]} \]

\[ t \text{[s]} \]

$v \text{[m/s]}$
Extension zone 2, stopping distance and stopping time

![Graph showing stopping distance and time vs. speed for different load factors]

- [Graph 1: Stopping distance (\(d_s\)) vs. speed (\(v\))] with load factors: m=100%, m=66%, m=33%
- [Graph 2: Stopping time (\(t_s\)) vs. speed (\(v\))] with load factors: m=100%, m=66%, m=33%
14 IRB 4600

14.1 IRB 4600 2.05 m 45 kg

Category 0

The following table describes the stopping distance and time for category 0 emergency stop at max speed, with the arm stretched out to the maximum with maximum load. All results are from tests on one moving axis.

<table>
<thead>
<tr>
<th>Axis</th>
<th>Distance (degrees)</th>
<th>Stop time (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>60.5</td>
<td>0.58</td>
</tr>
<tr>
<td>2</td>
<td>37.1</td>
<td>0.32</td>
</tr>
<tr>
<td>3</td>
<td>25.3</td>
<td>0.2</td>
</tr>
</tbody>
</table>

Category 1, extension zones

For definitions of the zones, see *Extension zones for articulated robots on page 14.*

<table>
<thead>
<tr>
<th>Zone</th>
<th>wcp min (m)</th>
<th>wcp max (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0.684</td>
</tr>
<tr>
<td>1</td>
<td>0.684</td>
<td>1.367</td>
</tr>
<tr>
<td>2</td>
<td>1.367</td>
<td>max reach</td>
</tr>
</tbody>
</table>

Category 1, Axis 1

Extension zone 0, stopping distance and stopping time

Continues on next page
Extension zone 1, stopping distance and stopping time
Extension zone 2, stopping distance and stopping time

![Graph 1](image1)

![Graph 2](image2)

Continues on next page
Category 1, Axis 2

Extension zone 0, stopping distance and stopping time

![Graph 1: \(\Phi [^\circ] vs. v [m/s]\)](image1)

![Graph 2: \(t [s] vs. v [m/s]\)](image2)
Extension zone 1, stopping distance and stopping time

![Graph of stopping distances and times for different mass loads (m=100%, m=66%, m=33%) as a function of velocity (v) in meters per second (m/s).]
Extension zone 2, stopping distance and stopping time

![Graph showing stopping distance and time vs. velocity](image-url)

Continued
Category 1, Axis 3

Extension zone 0, stopping distance and stopping time

![Graph 1: Stopping Distance (\(\Phi\) vs. \(v\))]

![Graph 2: Stopping Time (\(t\) vs. \(v\))]

Continues on next page
Extension zone 1, stopping distance and stopping time

![Graph 1: \(\phi_{hi}\) vs. \(v\)](image)

![Graph 2: \(t\) vs. \(v\)](image)
Extension zone 2, stopping distance and stopping time

![Graph showing stopping distance and time vs. speed for different load factors](image1)

![Graph showing stopping distance and time vs. speed for different load factors](image2)
Category 0

The following table describes the stopping distance and time for category 0 emergency stop at max speed, with the arm stretched out to the maximum with maximum load. All results are from tests on one moving axis.

<table>
<thead>
<tr>
<th>Axis</th>
<th>Distance (degrees)</th>
<th>Stop time (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>62.9</td>
<td>0.66</td>
</tr>
<tr>
<td>2</td>
<td>40.3</td>
<td>0.37</td>
</tr>
<tr>
<td>3</td>
<td>32.8</td>
<td>0.27</td>
</tr>
</tbody>
</table>

Category 1, extension zones

For definitions of the zones, see Extension zones for articulated robots on page 14.

<table>
<thead>
<tr>
<th>Zone</th>
<th>wcp min (m)</th>
<th>wcp max (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0.684</td>
</tr>
<tr>
<td>1</td>
<td>0.684</td>
<td>1.367</td>
</tr>
<tr>
<td>2</td>
<td>1.367</td>
<td>max reach</td>
</tr>
</tbody>
</table>

Category 1, Axis 1

Extension zone 0, stopping distance and stopping time

Continues on next page
Extension zone 1, stopping distance and stopping time
Extension zone 2, stopping distance and stopping time

![Graph showing stopping distances and times for different masses and velocities.]

Continues on next page
Category 1, Axis 2

Extension zone 0, stopping distance and stopping time

![Graph showing stopping distance and stopping time for different mass fractions](image-url)

Continues on next page
Extension zone 1, stopping distance and stopping time
Extension zone 2, stopping distance and stopping time

Graphs showing the stopping distance and stopping time for different masses (m=100%, m=66%, m=33%) as a function of velocity (v [m/s]).
Category 1, Axis 3

Extension zone 0, stopping distance and stopping time

![Graph showing stopping distance and time for different mass load percentages.](image-url)
Extension zone 1, stopping distance and stopping time

![Graphs showing stopping distance and time for different mass ratios](image-url)
Extension zone 2, stopping distance and stopping time

![Graph 1](image1)

![Graph 2](image2)
The following table describes the stopping distance and time for category 0 emergency stop at max speed, with the arm stretched out to the maximum with maximum load. All results are from tests on one moving axis.

<table>
<thead>
<tr>
<th>Axis</th>
<th>Distance (degrees)</th>
<th>Stop time (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>53.9</td>
<td>0.51</td>
</tr>
<tr>
<td>2</td>
<td>33.9</td>
<td>0.29</td>
</tr>
<tr>
<td>3</td>
<td>22.2</td>
<td>0.17</td>
</tr>
</tbody>
</table>

Category 1, extension zones

For definitions of the zones, see Extension zones for articulated robots on page 14.

<table>
<thead>
<tr>
<th>Zone</th>
<th>wcp min (m)</th>
<th>wcp max (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
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</tr>
<tr>
<td>1</td>
<td>0.838</td>
<td>1.675</td>
</tr>
<tr>
<td>2</td>
<td>1.675</td>
<td>max reach</td>
</tr>
</tbody>
</table>

Category 1, Axis 1

Extension zone 0, stopping distance and stopping time
Extension zone 1, stopping distance and stopping time
Extension zone 2, stopping distance and stopping time

![Graph showing stopping distance and time for different mass percentages.]

Continues on next page
Category 1, Axis 2

Extension zone 0, stopping distance and stopping time

---

Continues on next page
Extension zone 1, stopping distance and stopping time

![Graph showing stopping distance and time for different load ratios]

Continued
Extension zone 2, stopping distance and stopping time

![Graphs showing stopping distances and times for different mass loads (m=100%, m=66%, m=33%) at various velocities (v [m/s]).]
Category 1, Axis 3

Extension zone 0, stopping distance and stopping time

![Graph of stopping distance and stopping time]

- Graph 1: \( \Phi \) [\(^{\circ}\)] vs. \( v \) [m/s]
  - \( m=100\% \)
  - \( m=66\% \)
  - \( m=33\% \)

- Graph 2: \( t \) [s] vs. \( v \) [m/s]
  - \( m=100\% \)
  - \( m=66\% \)
  - \( m=33\% \)

Continues on next page
Extension zone 1, stopping distance and stopping time

![Graph showing stopping distance and stopping time](image)

Continues on next page
Extension zone 2, stopping distance and stopping time

![Graph 1: \( P \phi \) vs. \( v \)](image1)

- Red line: \( m = 100\% \)
- Green line: \( m = 66\% \)
- Blue line: \( m = 33\% \)

![Graph 2: \( t \) vs. \( v \)](image2)

- Red line: \( m = 100\% \)
- Green line: \( m = 66\% \)
- Blue line: \( m = 33\% \)
The following table describes the stopping distance and time for category 0 emergency stop at max speed, with the arm stretched out to the maximum with maximum load. All results are from tests on one moving axis.

<table>
<thead>
<tr>
<th>Axis</th>
<th>Distance (degrees)</th>
<th>Stop time (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>61.7</td>
<td>0.71</td>
</tr>
<tr>
<td>2</td>
<td>41.9</td>
<td>0.37</td>
</tr>
<tr>
<td>3</td>
<td>30.2</td>
<td>0.25</td>
</tr>
</tbody>
</table>

Category 1, extension zones

For definitions of the zones, see *Extension zones for articulated robots on page 14.*

<table>
<thead>
<tr>
<th>Zone</th>
<th>wcp min (m)</th>
<th>wcp max (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0.851</td>
</tr>
<tr>
<td>1</td>
<td>0.851</td>
<td>1.701</td>
</tr>
<tr>
<td>2</td>
<td>1.701</td>
<td>max reach</td>
</tr>
</tbody>
</table>

Category 1, Axis 1

Extension zone 0, stopping distance and stopping time

![Graph](image)
Extension zone 1, stopping distance and stopping time

Continued
Extension zone 2, stopping distance and stopping time

---

Continued
Category 1, Axis 2

Extension zone 0, stopping distance and stopping time

![Graph showing stopping distance and stopping time for different mass levels (m=100%, m=66%, m=33%) for varying speeds (v [m/s]).]
Continued

Extension zone 1, stopping distance and stopping time

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Continues on next page
Extension zone 2, stopping distance and stopping time

![Graph showing stopping distance and time for different load conditions.](image-url)

Continues on next page
Category 1, Axis 3

Extension zone 0, stopping distance and stopping time

![Graph showing stopping distance and stopping time for different masses.](image)
Extension zone 1, stopping distance and stopping time

![Graph showing stopping distance and time vs. velocity]

- Graph 1: \( P_\text{H} \) [°] vs. \( v \) [m/s] for different load percentages (100%, 66%, 33%)
- Graph 2: \( t \) [s] vs. \( v \) [m/s] for different load percentages (100%, 66%, 33%)

Continues on next page
Extension zone 2, stopping distance and stopping time

![Graph showing stopping distance and time]

- Stopping distance $P_h$ as a function of velocity $v$
- Stopping time $t$ as a function of velocity $v$

---

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15 IRB 6620

15.1 IRB 6620 2.20 m 150 kg

Category 0
The following table describes the stopping distance and time for category 0 emergency stop at max speed, with the arm stretched out to the maximum with maximum load. All results are from tests on one moving axis.

<table>
<thead>
<tr>
<th>Axis</th>
<th>Distance (degrees)</th>
<th>Stop time (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>29.1</td>
<td>0.49</td>
</tr>
<tr>
<td>2</td>
<td>25.2</td>
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</tr>
<tr>
<td>3</td>
<td>19.0</td>
<td>0.29</td>
</tr>
</tbody>
</table>

Category 1, extension zones
For definitions of the zones, see Extension zones for articulated robots on page 14.

<table>
<thead>
<tr>
<th>Zone</th>
<th>wcp min (m)</th>
<th>wcp max (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0.735</td>
</tr>
<tr>
<td>1</td>
<td>0.735</td>
<td>1.47</td>
</tr>
<tr>
<td>2</td>
<td>1.47</td>
<td>max reach</td>
</tr>
</tbody>
</table>

Category 1, Axis 1
Extension zone 0, stopping distance and stopping time

Continues on next page
15.1 IRB 6620 2.20 m 150 kg

Continued
Extension zone 2, stopping distance and stopping time

![Graph 1: Stopping distance vs. speed](image1)

- Red line: m=100%
- Green line: m=66%
- Purple line: m=33%

![Graph 2: Stopping time vs. speed](image2)

- Red line: m=100%
- Green line: m=66%
- Purple line: m=33%

Continues on next page
Category 1, Axis 2

Extension zone 0, stopping distance and stopping time

![Graphs showing stopping distance and time for different mass fractions](image-url)
Extension zone 1, stopping distance and stopping time

![Graph depicting stopping distances and time for IRB 6620 at various speeds]

Continued
Extension zone 2, stopping distance and stopping time
Category 1, Axis 3

Extension zone 0, stopping distance and stopping time
Extension zone 1, stopping distance and stopping time
Extension zone 2, stopping distance and stopping time

![Graph showing stopping distance and time versus speed]

- Continuation
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Category 0

The following table describes the stopping distance and time for category 0 emergency stop at max speed, with the arm stretched out to the maximum with maximum load. All results are from tests on one moving axis.

<table>
<thead>
<tr>
<th>Axis</th>
<th>Distance (degrees)</th>
<th>Stop time (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>51.5</td>
<td>0.95</td>
</tr>
<tr>
<td>2</td>
<td>34.5</td>
<td>0.63</td>
</tr>
<tr>
<td>3</td>
<td>20.0</td>
<td>0.32</td>
</tr>
</tbody>
</table>

Category 1, extension zones

For definitions of the zones, see Extension zones for articulated robots on page 14.

<table>
<thead>
<tr>
<th>Zone</th>
<th>wcp min (m)</th>
<th>wcp max (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>1.013</td>
</tr>
<tr>
<td>1</td>
<td>1.013</td>
<td>2.026</td>
</tr>
<tr>
<td>2</td>
<td>2.026</td>
<td>max reach</td>
</tr>
</tbody>
</table>

Category 1, Axis 1

Extension zone 0, stopping distance and stopping time
Extension zone 1, stopping distance and stopping time
Extension zone 2, stopping distance and stopping time

Graphs showing the relationship between speed (v [m/s]) and stopping distance (Ph [°]) for different load percentages (m = 100%, m = 66%, m = 33%).

Graphs showing the relationship between speed (v [m/s]) and stopping time (t [s]) for different load percentages (m = 100%, m = 66%, m = 33%).

Continues on next page.
Category 1, Axis 2

Extension zone 0, stopping distance and stopping time

---

Continues on next page
Extension zone 1, stopping distance and stopping time

![Graph showing stopping distance and time vs. velocity](image)

- Plot 1: $P_h[\degree]$ vs. $v [m/s]$ for different masses ($m=100\%, m=66\%, m=33\%$).
- Plot 2: $t[s]$ vs. $v [m/s]$ for different masses ($m=100\%, m=66\%, m=33\%$).

Continues on next page
Extension zone 2, stopping distance and stopping time

![Graphs showing stopping distance and time for different masses (m=100%, m=66%, m=33%) as a function of velocity (v) in meters per second (m/s).]
Category 1, Axis 3

Extension zone 0, stopping distance and stopping time

![Graph showing stopping distance and stopping time for different mass levels (m=100%, m=66%, m=33%) as a function of velocity (v) in [m/s].]
Extension zone 1, stopping distance and stopping time

![Graph showing stopping distance and time versus velocity](image)

Continues on next page
Extension zone 2, stopping distance and stopping time

![Graph](image)

- **P**h [°C]
- **t** [s]
- **m** = 100%, 66%, 33%

**v** [m/s]
16.2 IRB 6650S 3.45 m 125 kg

Category 0

The following table describes the stopping distance and time for category 0 emergency stop at max speed, with the arm stretched out to the maximum with maximum load. All results are from tests on one moving axis.

<table>
<thead>
<tr>
<th>Axis</th>
<th>Distance (degrees)</th>
<th>Stop time (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>52.8</td>
<td>0.95</td>
</tr>
<tr>
<td>2</td>
<td>33.4</td>
<td>0.61</td>
</tr>
<tr>
<td>3</td>
<td>20.3</td>
<td>0.32</td>
</tr>
</tbody>
</table>

Category 1, extension zones

For definitions of the zones, see *Extension zones for articulated robots on page 14.*

<table>
<thead>
<tr>
<th>Zone</th>
<th>wcp min (m)</th>
<th>wcp max (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>1.161</td>
</tr>
<tr>
<td>1</td>
<td>1.161</td>
<td>2.323</td>
</tr>
<tr>
<td>2</td>
<td>2.323</td>
<td>max reach</td>
</tr>
</tbody>
</table>

Category 1, Axis 1

Extension zone 0, stopping distance and stopping time

Continues on next page
Extension zone 1, stopping distance and stopping time

Continues on next page
Extension zone 2, stopping distance and stopping time
Category 1, Axis 2

Extension zone 0, stopping distance and stopping time

![Graph showing stopping distance and stopping time for different load factors](image1)

![Graph showing stopping distance and stopping time for different load factors](image2)
Extension zone 1, stopping distance and stopping time

![Graphs showing stopping distance and time vs. velocity for IRB 6650S with different mass loads (100%, 66%, 33%)](image)

Continued
Extension zone 2, stopping distance and stopping time

![Graphs showing stopping distance and time vs. velocity](image-url)
Category 1, Axis 3

Extension zone 0, stopping distance and stopping time

---

Continued
Extension zone 1, stopping distance and stopping time

![Graph showing stopping distance and time for various speeds and loads.](image)

Continued
Extension zone 2, stopping distance and stopping time

![Graphs showing stopping distance and time for different mass ratios (m=100%, m=66%, m=33%) vs. velocity (v)]
16.3 IRB 6650S 3.90 m 90 kg

Category 0

The following table describes the stopping distance and time for category 0 emergency stop at max speed, with the arm stretched out to the maximum with maximum load. All results are from tests on one moving axis.

<table>
<thead>
<tr>
<th>Axis</th>
<th>Distance (degrees)</th>
<th>Stop time (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>51.2</td>
<td>0.97</td>
</tr>
<tr>
<td>2</td>
<td>37.0</td>
<td>0.68</td>
</tr>
<tr>
<td>3</td>
<td>23.9</td>
<td>0.39</td>
</tr>
</tbody>
</table>

Category 1, extension zones

For definitions of the zones, see Extension zones for articulated robots on page 14.

<table>
<thead>
<tr>
<th>Zone</th>
<th>wcp min (m)</th>
<th>wcp max (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>1.311</td>
</tr>
<tr>
<td>1</td>
<td>1.311</td>
<td>2.621</td>
</tr>
<tr>
<td>2</td>
<td>2.621</td>
<td>max reach</td>
</tr>
</tbody>
</table>

Category 1, Axis 1

Extension zone 0, stopping distance and stopping time
Extension zone 1, stopping distance and stopping time

Continues on next page
Extension zone 2, stopping distance and stopping time

Graph 1: \( \theta_r [^\circ] \) vs. \( v [m/s] \)

Graph 2: \( t_s [s] \) vs. \( v [m/s] \)
Category 1, Axis 2

Extension zone 0, stopping distance and stopping time

![Graphs showing stopping distances and times for different masses (m=100%, m=66%, m=33%) for varying velocities (v [m/s]).]
Extension zone 1, stopping distance and stopping time
Extension zone 2, stopping distance and stopping time

![Graph showing stopping distance and time for IRB 6650S 3.90 m 90 kg](image)
Category 1, Axis 3

Extension zone 0, stopping distance and stopping time

![Graph 1: Stopping Distance (\(\Phi_1\) vs. \(v\))](image1)

![Graph 2: Stopping Time (\(t\) vs. \(v\))](image2)
Extension zone 1, stopping distance and stopping time
Extension zone 2, stopping distance and stopping time

![Graph showing stopping distance and time vs. speed](image1)

![Graph showing stopping distance and time vs. speed](image2)
16.4 IRB 6650S LeanID 3.0 m 190 kg

Category 0

The following table describes the stopping distance and time for category 0 emergency stop at max speed, with the arm stretched out to the maximum with maximum load. All results are from tests on one moving axis.

<table>
<thead>
<tr>
<th>Axis</th>
<th>Distance (degrees)</th>
<th>Stop time (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>45.7</td>
<td>0.83</td>
</tr>
<tr>
<td>2</td>
<td>26.2</td>
<td>0.46</td>
</tr>
<tr>
<td>3</td>
<td>13.8</td>
<td>0.22</td>
</tr>
</tbody>
</table>

Category 1, extension zones

For definitions of the zones, see Extension zones for articulated robots on page 14.

<table>
<thead>
<tr>
<th>Zone</th>
<th>wcp min (m)</th>
<th>wcp max (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>1.013</td>
</tr>
<tr>
<td>1</td>
<td>1.013</td>
<td>2.027</td>
</tr>
<tr>
<td>2</td>
<td>2.027</td>
<td>max reach</td>
</tr>
</tbody>
</table>

Category 1, Axis 1

Extension zone 0, stopping distance and stopping time

![Graph showing stopping distance and time for Category 1, Axis 1, Extension zone 0]
Extension zone 1, stopping distance and stopping time
Extension zone 2, stopping distance and stopping time

---

Continued on next page
Category 1, Axis 2

Extension zone 0, stopping distance and stopping time

![Graph 1: Φ(t) vs. v (m/s)](image1)

- Red line: m=100%
- Green dashed line: m=66%
- Blue dotted line: m=33%

![Graph 2: t vs. v (m/s)](image2)

- Red line: m=100%
- Green dashed line: m=66%
- Blue dotted line: m=33%

Continues on next page
Extension zone 1, stopping distance and stopping time

![Graphs showing stopping distance and time for different masses (m=100%, m=66%, m=33%) against velocity (v) in meters per second (m/s).]
Extension zone 2, stopping distance and stopping time

![Graph 1](image1)

- $P_t$ [°]
- $v$ [m/s]
- $m = 100\%$
- $m = 66\%$
- $m = 33\%$

![Graph 2](image2)

- $t$ [s]
- $v$ [m/s]
- $m = 100\%$
- $m = 66\%$
- $m = 33\%$
Category 1, Axis 3

Extension zone 0, stopping distance and stopping time

![Graph showing stopping distance and time vs. velocity](image_url)
Extension zone 1, stopping distance and stopping time

![Graph 1](chart1.png)

![Graph 2](chart2.png)
Extension zone 2, stopping distance and stopping time

![Graph 1: Phi vs. v]

![Graph 2: t vs. v]

Continued
Category 0

The following table describes the stopping distance and time for category 0 emergency stop at max speed, with the arm stretched out to the maximum with maximum load. All results are from tests on one moving axis.

<table>
<thead>
<tr>
<th>Axis</th>
<th>Distance (degrees)</th>
<th>Stop time (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>50.6</td>
<td>0.9</td>
</tr>
<tr>
<td>2</td>
<td>34.9</td>
<td>0.66</td>
</tr>
<tr>
<td>3</td>
<td>20.5</td>
<td>0.34</td>
</tr>
</tbody>
</table>

Category 1, extension zones

For definitions of the zones, see Extension zones for articulated robots on page 14.

<table>
<thead>
<tr>
<th>Zone</th>
<th>wcp min (m)</th>
<th>wcp max (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>1.162</td>
</tr>
<tr>
<td>1</td>
<td>1.162</td>
<td>2.323</td>
</tr>
<tr>
<td>2</td>
<td>2.323</td>
<td>max reach</td>
</tr>
</tbody>
</table>

Category 1, Axis 1

Extension zone 0, stopping distance and stopping time

![Graph showing stopping distance and time for category 0 emergency stop at max speed.](image)
Extension zone 1, stopping distance and stopping time
Extension zone 2, stopping distance and stopping time

Continued
Category 1, Axis 2

Extension zone 0, stopping distance and stopping time
Extension zone 1, stopping distance and stopping time

Graphs showing stopping distance (\(P_h\)) and stopping time (\(t\)) as a function of velocity (\(v\)).
Extension zone 2, stopping distance and stopping time
Category 1, Axis 3

Extension zone 0, stopping distance and stopping time

![Graph showing stopping distance and stopping time for different masses (m=100%, m=66%, m=33%) as a function of velocity (v) in meters per second (m/s).]
Extension zone 1, stopping distance and stopping time

![Graph 1](image1)

![Graph 2](image2)
Extension zone 2, stopping distance and stopping time

![Graphs showing stopping distance and stopping time for different speeds and mass ratios.](image-url)
This page is intentionally left blank
17 IRB 6660

17.1 IRB 6660 1.90 m 205 kg

Category 0

The following table describes the stopping distance and time for category 0 emergency stop at max speed, with the arm stretched out to the maximum with maximum load. All results are from tests on one moving axis.

<table>
<thead>
<tr>
<th>Axis</th>
<th>Distance (degrees)</th>
<th>Stop time (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>21.1</td>
<td>0.32</td>
</tr>
<tr>
<td>2</td>
<td>15.1</td>
<td>0.15</td>
</tr>
<tr>
<td>3</td>
<td>19.6</td>
<td>0.27</td>
</tr>
</tbody>
</table>

Category 1, extension zones

For definitions of the zones, see Extension zones for articulated robots on page 14.

<table>
<thead>
<tr>
<th>Zone</th>
<th>wcp min (m)</th>
<th>wcp max (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0.644</td>
</tr>
<tr>
<td>1</td>
<td>0.644</td>
<td>1.289</td>
</tr>
<tr>
<td>2</td>
<td>1.289</td>
<td>max reach</td>
</tr>
</tbody>
</table>

Category 1, Axis 1

Extension zone 0, stopping distance and stopping time

Continues on next page
Extension zone 1, stopping distance and stopping time
Extension zone 2, stopping distance and stopping time

![Graph showing stopping distance and time for different load percentages.]

Continues on next page
Category 1, Axis 2

Extension zone 0, stopping distance and stopping time

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Continued
Extension zone 1, stopping distance and stopping time
Extension zone 2, stopping distance and stopping time

Graphs showing stopping distance and time for different mass fractions (m = 100%, m = 66%, m = 33%) against velocity (v) in meters per second (m/s).
Category 1, Axis 3

Extension zone 0, stopping distance and stopping time

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Continued
Extension zone 1, stopping distance and stopping time

![Graph showing stopping distance and stopping time for different load factors (m = 100%, m = 66%, m = 33%) at various speeds (v in m/s).]
Extension zone 2, stopping distance and stopping time

![Graphs showing stopping distance and time vs. velocity for different masses (m=100%, m=66%, m=33%)](image-url)
The following table describes the stopping distance and time for category 0 emergency stop at max speed, with the arm stretched out to the maximum with maximum load. All results are from tests on one moving axis.

<table>
<thead>
<tr>
<th>Axis</th>
<th>Distance (degrees)</th>
<th>Stop time (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>39.8</td>
<td>0.61</td>
</tr>
<tr>
<td>2</td>
<td>34.0</td>
<td>0.42</td>
</tr>
<tr>
<td>3</td>
<td>36.6</td>
<td>0.44</td>
</tr>
</tbody>
</table>

Category 1, extension zones

For definitions of the zones, see Extension zones for articulated robots on page 14.

<table>
<thead>
<tr>
<th>Zone</th>
<th>wcp min (m)</th>
<th>wcp max (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>1.035</td>
</tr>
<tr>
<td>1</td>
<td>1.035</td>
<td>2.071</td>
</tr>
<tr>
<td>2</td>
<td>2.071</td>
<td>max reach</td>
</tr>
</tbody>
</table>

Category 1, Axis 1

Extension zone 0, stopping distance and stopping time
Extension zone 1, stopping distance and stopping time

Continues on next page
Extension zone 2, stopping distance and stopping time

![Graph showing stopping distance and time for different mass percentages.](image-url)
Category 1, Axis 2

Extension zone 0, stopping distance and stopping time
Extension zone 1, stopping distance and stopping time

![Graph showing stopping distance and time for different velocities and masses](image-url)
Extension zone 2, stopping distance and stopping time

![Graphs of stopping distance and time]

Continues on next page
Category 1, Axis 3

Extension zone 0, stopping distance and stopping time

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Continues on next page
Extension zone 1, stopping distance and stopping time

![Graphs showing stopping distance and stopping time for different masses and velocities.](image-url)
Extension zone 2, stopping distance and stopping time

![Graph showing stopping distance and stopping time for different speeds and mass percentages.](image)
17.3 IRB 6660 3.35 m 100 kg

Category 0

The following table describes the stopping distance and time for category 0 emergency stop at max speed, with the arm stretched out to the maximum with maximum load. All results are from tests on one moving axis.

<table>
<thead>
<tr>
<th>Axis</th>
<th>Distance (degrees)</th>
<th>Stop time (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>40.1</td>
<td>0.63</td>
</tr>
<tr>
<td>2</td>
<td>33.9</td>
<td>0.42</td>
</tr>
<tr>
<td>3</td>
<td>36.5</td>
<td>0.46</td>
</tr>
</tbody>
</table>

Category 1, extension zones

For definitions of the zones, see Extension zones for articulated robots on page 14.

<table>
<thead>
<tr>
<th>Zone</th>
<th>wcp min (m)</th>
<th>wcp max (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>1.118</td>
</tr>
<tr>
<td>1</td>
<td>1.118</td>
<td>2.235</td>
</tr>
<tr>
<td>2</td>
<td>2.235</td>
<td>max reach</td>
</tr>
</tbody>
</table>

Category 1, Axis 1

Extension zone 0, stopping distance and stopping time

Continues on next page
Extension zone 1, stopping distance and stopping time
Extension zone 2, stopping distance and stopping time

![Graph 1](image1)

![Graph 2](image2)
Category 1, Axis 2
Extension zone 0, stopping distance and stopping time

![Graph of stopping distance and time vs. speed](image1)

Continued
Extension zone 1, stopping distance and stopping time

[Graph showing stopping distance and time vs. speed]

Continued
Extension zone 2, stopping distance and stopping time

![Graph 1](image1)

![Graph 2](image2)
Category 1, Axis 3
Extension zone 0, stopping distance and stopping time

Continued
Extension zone 1, stopping distance and stopping time

![Graph of stopping distance and time vs. velocity]

Continues on next page
Extension zone 2, stopping distance and stopping time
**Category 0**

The following table describes the stopping distance and time for category 0 emergency stop at max speed, with the arm stretched out to the maximum with maximum load. All results are from tests on one moving axis.

<table>
<thead>
<tr>
<th>Axis</th>
<th>Distance (degrees)</th>
<th>Stop time (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>40.8</td>
<td>0.66</td>
</tr>
<tr>
<td>2</td>
<td>25.1</td>
<td>0.37</td>
</tr>
<tr>
<td>3</td>
<td>19.3</td>
<td>0.25</td>
</tr>
</tbody>
</table>

**Category 1, extension zones**

For definitions of the zones, see *Extension zones for articulated robots on page 14*.

<table>
<thead>
<tr>
<th>Zone</th>
<th>wcp min (m)</th>
<th>wcp max (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0.867</td>
</tr>
<tr>
<td>1</td>
<td>0.867</td>
<td>1.734</td>
</tr>
<tr>
<td>2</td>
<td>1.734</td>
<td>max reach</td>
</tr>
</tbody>
</table>

**Category 1, Axis 1**

Extension zone 0, stopping distance and stopping time

![Graph showing stopping distance and time for category 1, Axis 1](image-url)
Extension zone 1, stopping distance and stopping time
Extension zone 2, stopping distance and stopping time

![Graph showing stopping distance and stopping time for different masses.]

Continues on next page
Category 1, Axis 2

Extension zone 0, stopping distance and stopping time
Extension zone 1, stopping distance and stopping time

![Graph of stopping distance and stopping time for different masses (m=100%, m=66%, m=33%) as a function of velocity (v [m/s])](image1)

![Graph of stopping distance and stopping time for different masses (m=100%, m=66%, m=33%) as a function of velocity (v [m/s])](image2)
Extension zone 2, stopping distance and stopping time

![Graph showing stopping distances and times](image-url)
Category 1, Axis 3

Extension zone 0, stopping distance and stopping time

![Graph 1: Angular displacement vs. velocity](image1)

![Graph 2: Time vs. velocity](image2)

Continued
Extension zone 1, stopping distance and stopping time

![Graph showing stopping distance and time for different values of m (100%, 66%, 33%) vs. speed (v) in m/s.]

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Continued
Extension zone 2, stopping distance and stopping time

![Graph showing extension zone 2, stopping distance and stopping time for different load conditions (m=100%, m=66%, m=33%). The graphs illustrate the relationship between speed (v [m/s]) and stopping distance or time (Ph, t [s]) for varying load masses.](image)
The following table describes the stopping distance and time for category 0 emergency stop at max speed, with the arm stretched out to the maximum with maximum load. All results are from tests on one moving axis.

<table>
<thead>
<tr>
<th>Axis</th>
<th>Distance (degrees)</th>
<th>Stop time (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>38.2</td>
<td>0.68</td>
</tr>
<tr>
<td>2</td>
<td>20.3</td>
<td>0.37</td>
</tr>
<tr>
<td>3</td>
<td>14.4</td>
<td>0.22</td>
</tr>
</tbody>
</table>

Category 1, extension zones

For definitions of the zones, see Extension zones for articulated robots on page 14.

<table>
<thead>
<tr>
<th>Zone</th>
<th>wcp min (m)</th>
<th>wcp max (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0.883</td>
</tr>
<tr>
<td>1</td>
<td>0.883</td>
<td>1.767</td>
</tr>
<tr>
<td>2</td>
<td>1.767</td>
<td>max reach</td>
</tr>
</tbody>
</table>

Category 1, Axis 1

Extension zone 0, stopping distance and stopping time

Continues on next page
Extension zone 1, stopping distance and stopping time

Continues on next page
Extension zone 2, stopping distance and stopping time

![Graph showing stopping distance and time for different mass percentages.](image)
Category 1, Axis 2

Extension zone 0, stopping distance and stopping time

![Graph showing stopping distance and time vs. velocity](image)

- Continues on next page
Extension zone 1, stopping distance and stopping time
Extension zone 2, stopping distance and stopping time

![Graph showing stopping distance and time vs. velocity for different load conditions.](image-url)
Category 1, Axis 3

Extension zone 0, stopping distance and stopping time

![Graph 1: \( \Phi_\text{sl} [\text{\degree}] \) vs. \( v [\text{m/s}] \)]

![Graph 2: \( t [\text{s}] \) vs. \( v [\text{m/s}] \)]
Extension zone 1, stopping distance and stopping time

![Graph showing stopping distances and times for different masses (m=100%, m=66%, m=33%) as a function of velocity (v) in m/s.](image1)

![Graph showing stopping distances and times for different masses (m=100%, m=66%, m=33%) as a function of velocity (v) in m/s.](image2)
Extension zone 2, stopping distance and stopping time
18.3 IRB 6700 2.70 m 300 kg

Category 0

The following table describes the stopping distance and time for category 0 emergency stop at max speed, with the arm stretched out to the maximum with maximum load. All results are from tests on one moving axis.

<table>
<thead>
<tr>
<th>Axis</th>
<th>Distance (degrees)</th>
<th>Stop time (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>37.4</td>
<td>0.66</td>
</tr>
<tr>
<td>2</td>
<td>21.6</td>
<td>0.39</td>
</tr>
<tr>
<td>3</td>
<td>17.5</td>
<td>0.27</td>
</tr>
</tbody>
</table>

Category 1, extension zones

For definitions of the zones, see *Extension zones for articulated robots on page 14*.

<table>
<thead>
<tr>
<th>Zone</th>
<th>wcp min (m)</th>
<th>wcp max (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0.907</td>
</tr>
<tr>
<td>1</td>
<td>0.907</td>
<td>1.813</td>
</tr>
<tr>
<td>2</td>
<td>1.813</td>
<td>max reach</td>
</tr>
</tbody>
</table>

Category 1, Axis 1

Extension zone 0, stopping distance and stopping time

![Graph](image-url)
Extension zone 1, stopping distance and stopping time

Continues on next page
Extension zone 2, stopping distance and stopping time

![Graph showing stopping distance and time vs. speed](image)

- **Graph 1**: Phi [°] vs. v [m/s] for different mass percentages (m=100%, m=66%, m=33%)
- **Graph 2**: t [s] vs. v [m/s] for different mass percentages (m=100%, m=66%, m=33%)

Continues on next page
Category 1, Axis 2

Extension zone 0, stopping distance and stopping time
Extension zone 1, stopping distance and stopping time

![Graph showing stopping distance and time versus velocity for different load factors.]

18 IRB 6700

18.3 IRB 6700 2.70 m 300 kg

Continued
Extension zone 2, stopping distance and stopping time

![Graphs showing stopping distance and time for different speeds and load factors.](image)

Continues on next page
Category 1, Axis 3

Extension zone 0, stopping distance and stopping time

![Graph showing stopping distance and time vs. velocity for different mass percentages.](image-url)
Extension zone 1, stopping distance and stopping time
Extension zone 2, stopping distance and stopping time

![Graph showing stopping distance and time vs. speed]

- **$P_H$ [°C]**
- **$t$ [s]**
- **$m=100\%$**
- **$m=66\%$**
- **$m=33\%$**

$v$ [m/s]
The following table describes the stopping distance and time for category 0 emergency stop at max speed, with the arm stretched out to the maximum with maximum load. All results are from tests on one moving axis.

<table>
<thead>
<tr>
<th>Axis</th>
<th>Distance (degrees)</th>
<th>Stop time (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>40.0</td>
<td>0.71</td>
</tr>
<tr>
<td>2</td>
<td>20.6</td>
<td>0.37</td>
</tr>
<tr>
<td>3</td>
<td>14.1</td>
<td>0.22</td>
</tr>
</tbody>
</table>

Category 1, extension zones

For definitions of the zones, see Extension zones for articulated robots on page 14.

<table>
<thead>
<tr>
<th>Zone</th>
<th>wcp min (m)</th>
<th>wcp max (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0.931</td>
</tr>
<tr>
<td>1</td>
<td>0.931</td>
<td>1.863</td>
</tr>
<tr>
<td>2</td>
<td>1.863</td>
<td>max reach</td>
</tr>
</tbody>
</table>

Category 1, Axis 1

Extension zone 0, stopping distance and stopping time
Extension zone 1, stopping distance and stopping time
Extension zone 2, stopping distance and stopping time
Extension zone 0, stopping distance and stopping time

![Graph 1](image1)

![Graph 2](image2)
Extension zone 1, stopping distance and stopping time
Extension zone 2, stopping distance and stopping time

![Graph showing stopping distance and time vs. velocity](image)

Continued
Category 1, Axis 3
Extension zone 0, stopping distance and stopping time

![Graph showing stopping distances and times for different mass ratios (m=100%, m=66%, m=33%).](image)

Continued
Extension zone 1, stopping distance and stopping time

![Graphs showing stopping distance and time versus velocity for different masses (m=100%, m=66%, m=33%)]
Extension zone 2, stopping distance and stopping time

![Graph of stopping distance and time vs. speed]

Continued
18.5 IRB 6700 2.85 m 155 kg

Category 0

The following table describes the stopping distance and time for category 0 emergency stop at max speed, with the arm stretched out to the maximum with maximum load. All results are from tests on one moving axis.

<table>
<thead>
<tr>
<th>Axis</th>
<th>Distance (degrees)</th>
<th>Stop time (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>40.9</td>
<td>0.66</td>
</tr>
<tr>
<td>2</td>
<td>25.1</td>
<td>0.37</td>
</tr>
<tr>
<td>3</td>
<td>19.3</td>
<td>0.25</td>
</tr>
</tbody>
</table>

Category 1, extension zones

For definitions of the zones, see Extension zones for articulated robots on page 14.

<table>
<thead>
<tr>
<th>Zone</th>
<th>wcp min (m)</th>
<th>wcp max (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0.949</td>
</tr>
<tr>
<td>1</td>
<td>0.949</td>
<td>1.898</td>
</tr>
<tr>
<td>2</td>
<td>1.898</td>
<td>max reach</td>
</tr>
</tbody>
</table>

Category 1, Axis 1

Extension zone 0, stopping distance and stopping time

Continues on next page
Extension zone 1, stopping distance and stopping time
Extension zone 2, stopping distance and stopping time

![Graph showing stopping distance and time vs. velocity for different mass percentages]
Category 1, Axis 2

Extension zone 0, stopping distance and stopping time

![Graphs showing stopping distance and time for different speeds and mass ratios (m=100%, m=66%, m=33%).]
Extension zone 1, stopping distance and stopping time

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Continued
Extension zone 2, stopping distance and stopping time
Category 1, Axis 3

Extension zone 0, stopping distance and stopping time

![Graphs showing stopping distances and times for different masses and speeds.]

Continues on next page
Extension zone 1, stopping distance and stopping time

![Graphs showing stopping distance and time vs. velocity for different mass loads.](image-url)
Extension zone 2, stopping distance and stopping time

![Graphs showing stopping distance and time for different masses (m=100%, m=66%, m=33%) as a function of velocity (v) in meters per second.](image)
Category 0

The following table describes the stopping distance and time for category 0 emergency stop at max speed, with the arm stretched out to the maximum with maximum load. All results are from tests on one moving axis.

<table>
<thead>
<tr>
<th>Axis</th>
<th>Distance (degrees)</th>
<th>Stop time (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>38.8</td>
<td>0.68</td>
</tr>
<tr>
<td>2</td>
<td>21.7</td>
<td>0.39</td>
</tr>
<tr>
<td>3</td>
<td>17.9</td>
<td>0.29</td>
</tr>
</tbody>
</table>

Category 1, extension zones

For definitions of the zones, see Extension zones for articulated robots on page 14.

<table>
<thead>
<tr>
<th>Zone</th>
<th>wcp min (m)</th>
<th>wcp max (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0.989</td>
</tr>
<tr>
<td>1</td>
<td>0.989</td>
<td>1.978</td>
</tr>
<tr>
<td>2</td>
<td>1.978</td>
<td>max reach</td>
</tr>
</tbody>
</table>

Category 1, Axis 1

Extension zone 0, stopping distance and stopping time

Continues on next page
Extension zone 1, stopping distance and stopping time

Continues on next page
Extension zone 2, stopping distance and stopping time

![Graph showing stopping distance and stopping time for different speeds and masses.](image)

Continued
Category 1, Axis 2

Extension zone 0, stopping distance and stopping time

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Continues on next page
Extension zone 1, stopping distance and stopping time

---

Continued on next page
Extension zone 2, stopping distance and stopping time

![Graphs showing stopping distance and time for different mass percentages.]

Continued
Category 1, Axis 3

Extension zone 0, stopping distance and stopping time

![Graph showing stopping distance and time vs. velocity for different mass ratios](image)

Continues on next page
Extension zone 1, stopping distance and stopping time

Continues on next page
Extension zone 2, stopping distance and stopping time
18.7 IRB 6700 3.05 m 175 kg

Category 0

The following table describes the stopping distance and time for category 0 emergency stop at max speed, with the arm stretched out to the maximum with maximum load. All results are from tests on one moving axis.

<table>
<thead>
<tr>
<th>Axis</th>
<th>Distance (degrees)</th>
<th>Stop time (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>40.9</td>
<td>0.73</td>
</tr>
<tr>
<td>2</td>
<td>21.1</td>
<td>0.37</td>
</tr>
<tr>
<td>3</td>
<td>15.6</td>
<td>0.25</td>
</tr>
</tbody>
</table>

Category 1, extension zones

For definitions of the zones, see Extension zones for articulated robots on page 14.

<table>
<thead>
<tr>
<th>Zone</th>
<th>wcp min (m)</th>
<th>wcp max (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>1.019</td>
</tr>
<tr>
<td>1</td>
<td>1.019</td>
<td>2.037</td>
</tr>
<tr>
<td>2</td>
<td>2.037</td>
<td>max reach</td>
</tr>
</tbody>
</table>

Category 1, Axis 1

Extension zone 0, stopping distance and stopping time

![Graph showing stopping distance and stopping time for different loads]

Continues on next page
Extension zone 1, stopping distance and stopping time
Extension zone 2, stopping distance and stopping time

![Graphs showing stopping distance and time for different load capacities](image-url)
Category 1, Axis 2

Extension zone 0, stopping distance and stopping time

![Graphs showing stopping distance and time vs. velocity for different mass percentages.]
Extension zone 1, stopping distance and stopping time

![Graph showing stopping distance and stopping time for different masses (m=100%, m=66%, m=33%) as a function of velocity (v) in m/s.]

Continued
Extension zone 2, stopping distance and stopping time

![Graph showing stopping distance and time for different percentiles (m=100%, m=66%, m=33%) against velocity (v) in meters per second (m/s).]
Category 1, Axis 3

Extension zone 0, stopping distance and stopping time

![Graph 1](image1)

![Graph 2](image2)
Extension zone 1, stopping distance and stopping time

![Graphs showing stopping distance and time in Extension zone 1.]

Continued
Extension zone 2, stopping distance and stopping time
Category 0

The following table describes the stopping distance and time for category 0 emergency stop at max speed, with the arm stretched out to the maximum with maximum load. All results are from tests on one moving axis.

<table>
<thead>
<tr>
<th>Axis</th>
<th>Distance (degrees)</th>
<th>Stop time (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>41.7</td>
<td>0.75</td>
</tr>
<tr>
<td>2</td>
<td>21.3</td>
<td>0.39</td>
</tr>
<tr>
<td>3</td>
<td>15.7</td>
<td>0.25</td>
</tr>
</tbody>
</table>

Category 1, extension zones

For definitions of the zones, see Extension zones for articulated robots on page 14.

<table>
<thead>
<tr>
<th>Zone</th>
<th>wcp min (m)</th>
<th>wcp max (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>1.067</td>
</tr>
<tr>
<td>1</td>
<td>1.067</td>
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<tr>
<td>2</td>
<td>2.133</td>
<td>max reach</td>
</tr>
</tbody>
</table>

Category 1, Axis 1

Extension zone 0, stopping distance and stopping time

Continues on next page
Extension zone 1, stopping distance and stopping time
Extension zone 2, stopping distance and stopping time

![Graph showing stopping distance and time vs. velocity](image)

Continued on next page
Category 1, Axis 2

Extension zone 0, stopping distance and stopping time

Continues on next page
Extension zone 1, stopping distance and stopping time
Extension zone 2, stopping distance and stopping time

![Graphs showing stopping distance and time vs. velocity for different mass values.]
Category 1, Axis 3

Extension zone 0, stopping distance and stopping time

\[ \Phi_i \text{ [°]} \]

\[ t [s] \]

\[ m = 100\% \]
\[ m = 66\% \]
\[ m = 33\% \]

v [m/s]

Continued
Extension zone 1, stopping distance and stopping time

Graphs showing the relationship between velocity (v) and stopping distance (P) and stopping time (t) for different load conditions (m=100%, m=66%, m=33%).
Extension zone 2, stopping distance and stopping time

![Graphs showing stopping distances and times for different mass percentages]
Category 0

The following table describes the stopping distance and time for category 0 emergency stop at max speed, with the arm stretched out to the maximum with maximum load. All results are from tests on one moving axis.

<table>
<thead>
<tr>
<th>Axis</th>
<th>Distance (degrees)</th>
<th>Stop time (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>33.1</td>
<td>0.58</td>
</tr>
<tr>
<td>2</td>
<td>21.0</td>
<td>0.37</td>
</tr>
<tr>
<td>3</td>
<td>14.7</td>
<td>0.22</td>
</tr>
</tbody>
</table>

Category 1, extension zones

For definitions of the zones, see Extension zones for articulated robots on page 14.

<table>
<thead>
<tr>
<th>Zone</th>
<th>wcp min (m)</th>
<th>wcp max (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0.872</td>
</tr>
<tr>
<td>1</td>
<td>0.872</td>
<td>1.744</td>
</tr>
<tr>
<td>2</td>
<td>1.744</td>
<td>max reach</td>
</tr>
</tbody>
</table>

Category 1, Axis 1

Extension zone 0, stopping distance and stopping time

![Graph showing stopping distance and time for category 0 emergency stop](graph.png)
Extension zone 1, stopping distance and stopping time
Extension zone 2, stopping distance and stopping time

Graphs showing stopping distances and times for different mass percentages (m=100%, m=66%, m=33%) as a function of velocity (v[m/s]).
Category 1, Axis 2

Extension zone 0, stopping distance and stopping time

![Graph of stopping distance and time vs. velocity]

Continued
Extension zone 1, stopping distance and stopping time

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Continued
Extension zone 2, stopping distance and stopping time

![Graphs showing stopping distance and time vs. velocity for different mass percentages.](image)

Continued
Category 1, Axis 3

Extension zone 0, stopping distance and stopping time
Extension zone 1, stopping distance and stopping time

![Graph showing stopping distance vs speed for different mass percentages.](image)

![Graph showing stopping time vs speed for different mass percentages.](image)

Continued
Extension zone 2, stopping distance and stopping time
The following table describes the stopping distance and time for category 0 emergency stop at max speed, with the arm stretched out to the maximum with maximum load. All results are from tests on one moving axis.

<table>
<thead>
<tr>
<th>Axis</th>
<th>Distance (degrees)</th>
<th>Stop time (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>33.1</td>
<td>0.56</td>
</tr>
<tr>
<td>2</td>
<td>21.1</td>
<td>0.37</td>
</tr>
<tr>
<td>3</td>
<td>14.6</td>
<td>0.22</td>
</tr>
</tbody>
</table>

Category 1, extension zones
For definitions of the zones, see Extension zones for articulated robots on page 14.

<table>
<thead>
<tr>
<th>Zone</th>
<th>wcp min (m)</th>
<th>wcp max (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0.955</td>
</tr>
<tr>
<td>1</td>
<td>0.955</td>
<td>1.909</td>
</tr>
<tr>
<td>2</td>
<td>1.909</td>
<td>max reach</td>
</tr>
</tbody>
</table>

Category 1, Axis 1
Extension zone 0, stopping distance and stopping time
Extension zone 1, stopping distance and stopping time

Continues on next page
Extension zone 2, stopping distance and stopping time

![Graphs showing stopping distance and time vs. velocity for different mass percentages.](image-url)
Category 1, Axis 2

Extension zone 0, stopping distance and stopping time

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Continued
Extension zone 1, stopping distance and stopping time

![Graphs showing stopping distance and stopping time for different speeds and mass fractions.]

Continued
Extension zone 2, stopping distance and stopping time

![Graph showing stopping distance and time vs. velocity for different mass ratios: m=100%, m=66%, m=33%.

The graphs depict how the stopping distance and time vary with velocity for different mass ratios. The curves indicate increasing stopping distance and time as velocity increases, with higher mass ratios resulting in greater stopping distances and times. The graphs help in understanding the relationship between velocity and stopping parameters for robotic systems.]
Category 1, Axis 3

Extension zone 0, stopping distance and stopping time

![Graph 1: Phi vs. v]

![Graph 2: t vs. v]

Continues on next page
Extension zone 1, stopping distance and stopping time

![Graph showing stopping distance and time vs speed for different mass ratios.]

Continues on next page
Extension zone 2, stopping distance and stopping time

![Graphs showing stopping distance and time for different load fractions](image-url)
18.11 IRB 6700Inv 2.60 m 300 kg

**Category 0**

The following table describes the stopping distance and time for category 0 emergency stop at max speed, with the arm stretched out to the maximum with maximum load. All results are from tests on one moving axis.

<table>
<thead>
<tr>
<th>Axis</th>
<th>Distance (degrees)</th>
<th>Stop time (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>32.5</td>
<td>0.56</td>
</tr>
<tr>
<td>2</td>
<td>20.3</td>
<td>0.34</td>
</tr>
<tr>
<td>3</td>
<td>13.8</td>
<td>0.2</td>
</tr>
</tbody>
</table>

**Category 1, extension zones**

For definitions of the zones, see Extension zones for articulated robots on page 14.

<table>
<thead>
<tr>
<th>Zone</th>
<th>wcp min (m)</th>
<th>wcp max (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0.872</td>
</tr>
<tr>
<td>1</td>
<td>0.872</td>
<td>1.744</td>
</tr>
<tr>
<td>2</td>
<td>1.744</td>
<td>max reach</td>
</tr>
</tbody>
</table>

**Category 1, Axis 1**

Extension zone 0, stopping distance and stopping time

![Graph showing stopping distance and time for category 1, Axis 1.](image-url)
Extension zone 1, stopping distance and stopping time

Continues on next page
Extension zone 2, stopping distance and stopping time

Continues on next page
Category 1, Axis 2

Extension zone 0, stopping distance and stopping time

[Graphs showing Phi vs. v and t vs. v for different masses (m=100%, m=66%, m=33%).]
Extension zone 1, stopping distance and stopping time

![Graph showing stopping distance and time vs. velocity]

Continues on next page
Extension zone 2, stopping distance and stopping time

![Graph showing stopping distance and time vs. speed for different masses (m=100%, m=66%, m=33%)]
Category 1, Axis 3

Extension zone 0, stopping distance and stopping time
Continued

Extension zone 1, stopping distance and stopping time

![Graphs showing stopping distance and time vs. linear speed for different masses (m=100%, m=66%, m=33%).]
Extension zone 2, stopping distance and stopping time
### Category 0

The following table describes the stopping distance and time for category 0 emergency stop at max speed, with the arm stretched out to the maximum with maximum load. All results are from tests on one moving axis.

<table>
<thead>
<tr>
<th>Axis</th>
<th>Distance (degrees)</th>
<th>Stop time (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>31.4</td>
<td>0.54</td>
</tr>
<tr>
<td>2</td>
<td>20.0</td>
<td>0.34</td>
</tr>
<tr>
<td>3</td>
<td>13.2</td>
<td>0.2</td>
</tr>
</tbody>
</table>

### Category 1, extension zones

For definitions of the zones, see *Extension zones for articulated robots on page 14.*

<table>
<thead>
<tr>
<th>Zone</th>
<th>wcp min (m)</th>
<th>wcp max (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0.955</td>
</tr>
<tr>
<td>1</td>
<td>0.955</td>
<td>1.909</td>
</tr>
<tr>
<td>2</td>
<td>1.909</td>
<td>max reach</td>
</tr>
</tbody>
</table>

### Category 1, Axis 1

Extension zone 0, stopping distance and stopping time
Extension zone 1, stopping distance and stopping time

Continues on next page
Extension zone 2, stopping distance and stopping time

![Graphs showing stopping distance and time for different masses.]

Continues on next page
Category 1, Axis 2

Extension zone 0, stopping distance and stopping time

![Graph showing Phi vs. v and t vs. v for different percent loads (m=100%, m=66%, m=33%).]
Extension zone 1, stopping distance and stopping time

![Graph showing stopping distance and stopping time for different speeds and mass ratios.]

Continues on next page
Extension zone 2, stopping distance and stopping time

![Graph of stopping distance and time vs velocity](image-url)
Category 1, Axis 3

Extension zone 0, stopping distance and stopping time

![Graphs showing stopping distance and time vs. velocity for different mass loads (m=100%, m=66%, m=33%).]
Extension zone 1, stopping distance and stopping time
Extension zone 2, stopping distance and stopping time

![Graph showing stopping distance and time vs. speed](image)

- $P_h$ [°C]
- $t$ [s]
- Speed $v$ [m/s]
- $m=100\%$
- $m=66\%$
- $m=33\%$
18.13 IRB 6700

Category 0

The following table describes the stopping distance and time for category 0 emergency stop at max speed, with the arm stretched out to the maximum with maximum load. All results are from tests on one moving axis.

<table>
<thead>
<tr>
<th>Axis</th>
<th>Distance (degrees)</th>
<th>Stop time (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>36.6</td>
<td>0.58</td>
</tr>
<tr>
<td>2</td>
<td>24.4</td>
<td>0.34</td>
</tr>
<tr>
<td>3</td>
<td>15.7</td>
<td>0.2</td>
</tr>
</tbody>
</table>

Category 1, extension zones

For definitions of the zones, see *Extension zones for articulated robots on page 14*.

<table>
<thead>
<tr>
<th>Zone</th>
<th>wcp min (m)</th>
<th>wcp max (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0.867</td>
</tr>
<tr>
<td>1</td>
<td>0.867</td>
<td>1.734</td>
</tr>
<tr>
<td>2</td>
<td>1.734</td>
<td>max reach</td>
</tr>
</tbody>
</table>

Category 1, Axis 1

Extension zone 0, stopping distance and stopping time

![Graph showing stopping distance and time for category 1, Axis 1.](image-url)
18.13 IRB 6700 LeanID 2.60 m 175 kg

Continued

Extension zone 1, stopping distance and stopping time

Continues on next page
Extension zone 2, stopping distance and stopping time

![Graph showing stopping distance and time vs. velocity for different mass ratios (m=100%, m=66%, m=33%).]
Category 1, Axis 2

Extension zone 0, stopping distance and stopping time

![Graph 1: \(\Phi\) vs. \(v\)](image1)

![Graph 2: \(t\) vs. \(v\)](image2)

Continued
Extension zone 1, stopping distance and stopping time

\[ P_h [^\circ] \]

\[ t [s] \]

\( v [m/s] \)

\( m=100\% \)

\( m=66\% \)

\( m=33\% \)
Extension zone 2, stopping distance and stopping time

![Graphs showing stopping distance and time vs. velocity](image)

Continues on next page
Category 1, Axis 3

Extension zone 0, stopping distance and stopping time

Continued
Extension zone 1, stopping distance and stopping time

![Graph showing stopping distance and time vs. velocity for different masses (m=100%, m=66%, m=33%)]
Extension zone 2, stopping distance and stopping time

![Graph showing stopping distance and time for different masses (m=100%, m=66%, m=33%) as a function of velocity (v [m/s]).]
Category 0

The following table describes the stopping distance and time for category 0 emergency stop at max speed, with the arm stretched out to the maximum with maximum load. All results are from tests on one moving axis.

<table>
<thead>
<tr>
<th>Axis</th>
<th>Distance (degrees)</th>
<th>Stop time (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>35.8</td>
<td>0.63</td>
</tr>
<tr>
<td>2</td>
<td>19.5</td>
<td>0.34</td>
</tr>
<tr>
<td>3</td>
<td>12.3</td>
<td>0.17</td>
</tr>
</tbody>
</table>

Category 1, extension zones

For definitions of the zones, see Extension zones for articulated robots on page 14.

<table>
<thead>
<tr>
<th>Zone</th>
<th>wcp min (m)</th>
<th>wcp max (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0.883</td>
</tr>
<tr>
<td>1</td>
<td>0.883</td>
<td>1.767</td>
</tr>
<tr>
<td>2</td>
<td>1.767</td>
<td>max reach</td>
</tr>
</tbody>
</table>

Category 1, Axis 1

Extension zone 0, stopping distance and stopping time

Continues on next page
Extension zone 1, stopping distance and stopping time
Extension zone 2, stopping distance and stopping time

[Graph showing relationship between velocity (v) and stopping distance (Ph) and stopping time (t) for different mass (m) values: 100%, 66%, and 33%.

Note: Continues on next page]
Category 1, Axis 2

Extension zone 0, stopping distance and stopping time

![Graph showing stopping distance and time for different mass percentages.](image)

Continues on next page
Extension zone 1, stopping distance and stopping time

![Graphs showing stopping distances and times for different speeds and mass percentages.]

Continued
Extension zone 2, stopping distance and stopping time

![Graph showing stopping distance and time vs. velocity]
Category 1, Axis 3

Extension zone 0, stopping distance and stopping time

![Graph of stopping distance and stopping time vs. velocity](image1)

![Graph of time vs. velocity](image2)
Extension zone 1, stopping distance and stopping time

![Graph showing stopping distance and stopping time for different speeds.](image)

Continues on next page
Extension zone 2, stopping distance and stopping time
Category 0

The following table describes the stopping distance and time for category 0 emergency stop at max speed, with the arm stretched out to the maximum with maximum load. All results are from tests on one moving axis.

<table>
<thead>
<tr>
<th>Axis</th>
<th>Distance (degrees)</th>
<th>Stop time (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>35.2</td>
<td>0.61</td>
</tr>
<tr>
<td>2</td>
<td>20.8</td>
<td>0.37</td>
</tr>
<tr>
<td>3</td>
<td>14.9</td>
<td>0.22</td>
</tr>
</tbody>
</table>

Category 1, extension zones

For definitions of the zones, see Extension zones for articulated robots on page 14.

<table>
<thead>
<tr>
<th>Zone</th>
<th>wcp min (m)</th>
<th>wcp max (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0.907</td>
</tr>
<tr>
<td>1</td>
<td>0.907</td>
<td>1.813</td>
</tr>
<tr>
<td>2</td>
<td>1.813</td>
<td>max reach</td>
</tr>
</tbody>
</table>

Category 1, Axis 1

Extension zone 0, stopping distance and stopping time

Continues on next page
Extension zone 1, stopping distance and stopping time
Extension zone 2, stopping distance and stopping time

![Graph showing stopping distance and stopping time vs. velocity](image)

- m=100%
- m=66%
- m=33%

Continued
Category 1, Axis 2

Extension zone 0, stopping distance and stopping time
Extension zone 1, stopping distance and stopping time

Continues on next page
Extension zone 2, stopping distance and stopping time

![Graph of stopping distance vs. speed](image1)

![Graph of stopping time vs. speed](image2)
Category 1, Axis 3
Extension zone 0, stopping distance and stopping time

Graph 1: Plot of $\Phi_1$ vs. $v$ for different values of $m$.

Graph 2: Plot of $t$ vs. $v$ for different values of $m$.
Extension zone 1, stopping distance and stopping time

![Graph of stopping distance and time vs. velocity]

Continued
Extension zone 2, stopping distance and stopping time

![Graph showing stopping distance and time as functions of velocity for different masses (m=100%, m=66%, m=33%).]
Category 0

The following table describes the stopping distance and time for category 0 emergency stop at max speed, with the arm stretched out to the maximum with maximum load. All results are from tests on one moving axis.

<table>
<thead>
<tr>
<th>Axis</th>
<th>Distance (degrees)</th>
<th>Stop time (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>39.0</td>
<td>0.68</td>
</tr>
<tr>
<td>2</td>
<td>20.3</td>
<td>0.37</td>
</tr>
<tr>
<td>3</td>
<td>13.2</td>
<td>0.2</td>
</tr>
</tbody>
</table>

Category 1, extension zones

For definitions of the zones, see Extension zones for articulated robots on page 14.

<table>
<thead>
<tr>
<th>Zone</th>
<th>wcp min (m)</th>
<th>wcp max (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0.931</td>
</tr>
<tr>
<td>1</td>
<td>0.931</td>
<td>1.863</td>
</tr>
<tr>
<td>2</td>
<td>1.863</td>
<td>max reach</td>
</tr>
</tbody>
</table>

Category 1, Axis 1

Extension zone 0, stopping distance and stopping time
Extension zone 1, stopping distance and stopping time

Continues on next page
Extension zone 2, stopping distance and stopping time
Category 1, Axis 2

Extension zone 0, stopping distance and stopping time

Continues on next page
Extension zone 1, stopping distance and stopping time

![Graph showing stopping distance and time vs. speed]

- For $m=100\%$, the stopping distance and time are the highest.
- As $m$ decreases to $66\%$ and then $33\%$, both the stopping distance and time decrease.

Continues on next page
Extension zone 2, stopping distance and stopping time

![Graph showing stopping distance and time for different mass load ratios (m=100%, m=66%, m=33%) against velocity (v) in meters per second.](image)

Continued
Category 1, Axis 3

Extension zone 0, stopping distance and stopping time

![Graph showing stopping distance and time for different speeds and mass ratios.](image)

Continued
Extension zone 1, stopping distance and stopping time

![Graph showing stopping distance and time vs. velocity]

Continues on next page
Extension zone 2, stopping distance and stopping time
18.17 IRB 6700 LeanID 2.85 m 140 kg

Category 0

The following table describes the stopping distance and time for category 0 emergency stop at max speed, with the arm stretched out to the maximum with maximum load. All results are from tests on one moving axis.

<table>
<thead>
<tr>
<th>Axis</th>
<th>Distance (degrees)</th>
<th>Stop time (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>38.9</td>
<td>0.61</td>
</tr>
<tr>
<td>2</td>
<td>25.0</td>
<td>0.37</td>
</tr>
<tr>
<td>3</td>
<td>17.7</td>
<td>0.22</td>
</tr>
</tbody>
</table>

Category 1, extension zones

For definitions of the zones, see Extension zones for articulated robots on page 14.

<table>
<thead>
<tr>
<th>Zone</th>
<th>wcp min (m)</th>
<th>wcp max (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0.949</td>
</tr>
<tr>
<td>1</td>
<td>0.949</td>
<td>1.898</td>
</tr>
<tr>
<td>2</td>
<td>1.898</td>
<td>max reach</td>
</tr>
</tbody>
</table>

Category 1, Axis 1

Extension zone 0, stopping distance and stopping time

[Graph showing stopping distance and time for category 0]
Extension zone 1, stopping distance and stopping time
Extension zone 2, stopping distance and stopping time

![Graph showing stopping distance and time vs. speed for different mass scenarios.]

Continued
Category 1, Axis 2

Extension zone 0, stopping distance and stopping time

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Continued
Extension zone 1, stopping distance and stopping time

![Diagram showing stopping distance and time graphs for different load masses (m=100%, m=66%, m=33%).](image)

Continues on next page
Extension zone 2, stopping distance and stopping time
Category 1, Axis 3

Extension zone 0, stopping distance and stopping time
Extension zone 1, stopping distance and stopping time
Extension zone 2, stopping distance and stopping time

![Graph showing stopping distances and times for different speeds and masses.](image)
Category 0

The following table describes the stopping distance and time for category 0 emergency stop at max speed, with the arm stretched out to the maximum with maximum load. All results are from tests on one moving axis.

<table>
<thead>
<tr>
<th>Axis</th>
<th>Distance (degrees)</th>
<th>Stop time (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>36.6</td>
<td>0.63</td>
</tr>
<tr>
<td>2</td>
<td>20.9</td>
<td>0.37</td>
</tr>
<tr>
<td>3</td>
<td>16.1</td>
<td>0.25</td>
</tr>
</tbody>
</table>

Category 1, extension zones

For definitions of the zones, see Extension zones for articulated robots on page 14.

<table>
<thead>
<tr>
<th>Zone</th>
<th>wcp min (m)</th>
<th>wcp max (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0.989</td>
</tr>
<tr>
<td>1</td>
<td>0.989</td>
<td>1.978</td>
</tr>
<tr>
<td>2</td>
<td>1.978</td>
<td>max reach</td>
</tr>
</tbody>
</table>

Category 1, Axis 1

Extension zone 0, stopping distance and stopping time

Continues on next page
Extension zone 1, stopping distance and stopping time
Extension zone 2, stopping distance and stopping time

![Graph showing stopping distance and time vs. velocity](image)

Continued
Category 1, Axis 2

Extension zone 0, stopping distance and stopping time

![Graph showing Phi vs. v and t vs. v for different mass loads (m=100%, m=66%, m=33%)](image-url)

Continues on next page
Extension zone 1, stopping distance and stopping time

Continues on next page
Extension zone 2, stopping distance and stopping time

![Graph showing stopping distance and stopping time for different masses](image)

Continues on next page
Category 1, Axis 3

Extension zone 0, stopping distance and stopping time

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Continues on next page
Extension zone 1, stopping distance and stopping time

![Graph showing stopping distance and time vs. velocity for different mass percentages.]

Continues on next page
Extension zone 2, stopping distance and stopping time
Category 0

The following table describes the stopping distance and time for category 0 emergency stop at max speed, with the arm stretched out to the maximum with maximum load. All results are from tests on one moving axis.

<table>
<thead>
<tr>
<th>Axis</th>
<th>Distance (degrees)</th>
<th>Stop time (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>38.4</td>
<td>0.68</td>
</tr>
<tr>
<td>2</td>
<td>20.2</td>
<td>0.37</td>
</tr>
<tr>
<td>3</td>
<td>14.2</td>
<td>0.22</td>
</tr>
</tbody>
</table>

Category 1, extension zones

For definitions of the zones, see *Extension zones for articulated robots on page 14.*

<table>
<thead>
<tr>
<th>Zone</th>
<th>wcp min (m)</th>
<th>wcp max (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>1.019</td>
</tr>
<tr>
<td>1</td>
<td>1.019</td>
<td>2.037</td>
</tr>
<tr>
<td>2</td>
<td>2.037</td>
<td>max reach</td>
</tr>
</tbody>
</table>

Category 1, Axis 1

Extension zone 0, stopping distance and stopping time

![Graph showing stopping distance and time for category 1, Axis 1](image)
Extension zone 1, stopping distance and stopping time

Continued
Extension zone 2, stopping distance and stopping time

![Graph 1: \( P_h [\%] \) vs. \( v [m/s] \)]

![Graph 2: \( t [s] \) vs. \( v [m/s] \)]

Continues on next page
Category 1, Axis 2

Extension zone 0, stopping distance and stopping time

![Graph showing stopping distance and time vs. velocity]

Continued
Extension zone 1, stopping distance and stopping time

![Graph showing stopping distance and time vs. velocity for different masses m=100%, m=66%, m=33%.

Continues on next page.
Extension zone 2, stopping distance and stopping time

Continues on next page
Category 1, Axis 3

Extension zone 0, stopping distance and stopping time

![Graph showing stopping distance and time vs. speed for different mass percentages.]

Continued on next page
Extension zone 1, stopping distance and stopping time

\[ P_h (\degree) \]

\[ t [s] \]

\[ m=100\% \]
\[ m=66\% \]
\[ m=33\% \]
Extension zone 2, stopping distance and stopping time

![Graph showing stopping distance and stopping time for different masses (m=100%, m=66%, m=33%) at various velocities (v) in meters per second (m/s).]

The graphs illustrate the relationship between the product's speed (v) and stopping distance or stopping time (t) for different load masses (m). The red line represents 100% mass, the green line represents 66% mass, and the blue line represents 33% mass. As the speed increases, the stopping distance or time required for the product to stop also increases.

---

Product specification - Robot stopping distances according to ISO 10218-1

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Category 0

The following table describes the stopping distance and time for category 0 emergency stop at max speed, with the arm stretched out to the maximum with maximum load. All results are from tests on one moving axis.

<table>
<thead>
<tr>
<th>Axis</th>
<th>Distance (degrees)</th>
<th>Stop time (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>40.6</td>
<td>0.73</td>
</tr>
<tr>
<td>2</td>
<td>20.9</td>
<td>0.37</td>
</tr>
<tr>
<td>3</td>
<td>14.7</td>
<td>0.22</td>
</tr>
</tbody>
</table>

Category 1, extension zones

For definitions of the zones, see Extension zones for articulated robots on page 14.

<table>
<thead>
<tr>
<th>Zone</th>
<th>wcp min (m)</th>
<th>wcp max (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>1.067</td>
</tr>
<tr>
<td>1</td>
<td>1.067</td>
<td>2.133</td>
</tr>
<tr>
<td>2</td>
<td>2.133</td>
<td>max reach</td>
</tr>
</tbody>
</table>

Category 1, Axis 1

Extension zone 0, stopping distance and stopping time
Extension zone 1, stopping distance and stopping time

Continues on next page
Extension zone 2, stopping distance and stopping time

![Graph 1: Ph vs. v](image)

![Graph 2: t vs. v](image)

Continues on next page
Category 1, Axis 2

Extension zone 0, stopping distance and stopping time

Continued
Extension zone 1, stopping distance and stopping time

![Graph showing stopping distance and stopping time for different masses (m=100%, m=66%, m=33%) with respect to velocity (v) in meters per second (m/s).]
Extension zone 2, stopping distance and stopping time

Continues on next page
Category 1, Axis 3

Extension zone 0, stopping distance and stopping time
Extension zone 1, stopping distance and stopping time

![Graph showing stopping distance and time vs. velocity]

Continued
Extension zone 2, stopping distance and stopping time

![Graph showing stopping distance and time for different mass loads (m=100%, m=66%, m=33%) as a function of velocity (v) in meters per second (m/s).]
Category 0

The following table describes the stopping distance and time for category 0 emergency stop at max speed, with the arm stretched out to the maximum with maximum load. All results are from tests on one moving axis.

<table>
<thead>
<tr>
<th>Axis</th>
<th>Distance (degrees)</th>
<th>Stop time (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>38.2</td>
<td>0.68</td>
</tr>
<tr>
<td>2</td>
<td>20.3</td>
<td>0.37</td>
</tr>
<tr>
<td>3</td>
<td>14.4</td>
<td>0.22</td>
</tr>
</tbody>
</table>

Category 1, extension zones

For definitions of the zones, see *Extension zones for articulated robots on page 14.*

<table>
<thead>
<tr>
<th>Zone</th>
<th>wcp min (m)</th>
<th>wcp max (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0.883</td>
</tr>
<tr>
<td>1</td>
<td>0.883</td>
<td>1.767</td>
</tr>
<tr>
<td>2</td>
<td>1.767</td>
<td>max reach</td>
</tr>
</tbody>
</table>

Category 1, Axis 1

Extension zone 0, stopping distance and stopping time

[Graph showing stopping distance and time for different load levels.]
Extension zone 1, stopping distance and stopping time

Continues on next page
Extension zone 2, stopping distance and stopping time

![Graph of stopping distance and time vs. velocity]

Continues on next page
Category 1, Axis 2

Extension zone 0, stopping distance and stopping time
Extension zone 1, stopping distance and stopping time

![Graph showing stopping distance and stopping time for different speeds and mass percentages (m=100%, m=66%, m=33%).]
Extension zone 2, stopping distance and stopping time

![Graph showing stopping distance and time](image-url)
Category 1, Axis 3

Extension zone 0, stopping distance and stopping time

---

[Graphs showing stopping distance and time vs. velocity for different mass ratios (m=100%, m=66%, m=33%)]

Continues on next page
Extension zone 1, stopping distance and stopping time
Extension zone 2, stopping distance and stopping time

![Graph showing stopping distance vs. speed](image1)

![Graph showing stopping time vs. speed](image2)
Category 0

The following table describes the stopping distance and time for category 0 emergency stop at max speed, with the arm stretched out to the maximum with maximum load. All results are from tests on one moving axis.

<table>
<thead>
<tr>
<th>Axis</th>
<th>Distance (degrees)</th>
<th>Stop time (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>40.0</td>
<td>0.71</td>
</tr>
<tr>
<td>2</td>
<td>20.6</td>
<td>0.37</td>
</tr>
<tr>
<td>3</td>
<td>14.1</td>
<td>0.22</td>
</tr>
</tbody>
</table>

Category 1, extension zones

For definitions of the zones, see *Extension zones for articulated robots on page 14*.

<table>
<thead>
<tr>
<th>Zone</th>
<th>wcp min (m)</th>
<th>wcp max (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0.931</td>
</tr>
<tr>
<td>1</td>
<td>0.931</td>
<td>1.863</td>
</tr>
<tr>
<td>2</td>
<td>1.863</td>
<td>max reach</td>
</tr>
</tbody>
</table>

Category 1, Axis 1

Extension zone 0, stopping distance and stopping time
Extension zone 1, stopping distance and stopping time

Continues on next page
Extension zone 2, stopping distance and stopping time

![Graph showing stopping distance and time](image)

Continued
Category 1, Axis 2

Extension zone 0, stopping distance and stopping time

![Graph of stopping distance](image1)

![Graph of stopping time](image2)

Continues on next page
Extension zone 1, stopping distance and stopping time

![Graphs showing stopping distances and times for different speeds and mass percentages.]

Continued
Extension zone 2, stopping distance and stopping time

![Graph showing stopping distance and time for different speeds and masses.](image)
Category 1, Axis 3

Extension zone 0, stopping distance and stopping time
Extension zone 1, stopping distance and stopping time

![Graph of stopping distance and time vs. speed for different load percentages (m=100%, m=66%, m=33%).]
Extension zone 2, stopping distance and stopping time
Category 0

The following table describes the stopping distance and time for category 0 emergency stop at max speed, with the arm stretched out to the maximum with maximum load. All results are from tests on one moving axis.

<table>
<thead>
<tr>
<th>Axis</th>
<th>Distance (degrees)</th>
<th>Stop time (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>31.6</td>
<td>0.73</td>
</tr>
<tr>
<td>2</td>
<td>13.1</td>
<td>0.37</td>
</tr>
<tr>
<td>3</td>
<td>9.0</td>
<td>0.22</td>
</tr>
</tbody>
</table>

Category 1, extension zones

For definitions of the zones, see Extension zones for articulated robots on page 14.

<table>
<thead>
<tr>
<th>Zone</th>
<th>wcp min (m)</th>
<th>wcp max (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0.85</td>
</tr>
<tr>
<td>1</td>
<td>0.85</td>
<td>1.7</td>
</tr>
<tr>
<td>2</td>
<td>1.7</td>
<td>max reach</td>
</tr>
</tbody>
</table>

Category 1, Axis 1

Extension zone 0, stopping distance and stopping time
Extension zone 1, stopping distance and stopping time
Extension zone 2, stopping distance and stopping time

![Graphs showing stopping distance and time vs speed for different masses (m=100%, m=66%, m=33%).]
Category 1, Axis 2

Extension zone 0, stopping distance and stopping time

![Graph showing Phi vs. v and t vs. v for different masses (m=100%, m=66%, m=33%).]
Extension zone 1, stopping distance and stopping time

![Graph of stopping distance and time vs. velocity]

- $m = 100\%$
- $m = 66\%$
- $m = 33\%$

Continued
Extension zone 2, stopping distance and stopping time

![Graph showing stopping distance and time vs. velocity](image)

Continued
Category 1, Axis 3

Extension zone 0, stopping distance and stopping time

[Graphs showing stopping distance and time for different masses]
Extension zone 1, stopping distance and stopping time

![Graph showing stopping distances and times for different masses (m).

Graph 1: Stopping distance (P) vs. speed (v).
Graph 2: Stopping time (t) vs. speed (v).]
Extension zone 2, stopping distance and stopping time
20.2 IRB 7600 2.55 m 500 kg

Category 0

The following table describes the stopping distance and time for category 0 emergency stop at max speed, with the arm stretched out to the maximum with maximum load. All results are from tests on one moving axis.

<table>
<thead>
<tr>
<th>Axis</th>
<th>Distance (degrees)</th>
<th>Stop time (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>32.6</td>
<td>0.75</td>
</tr>
<tr>
<td>2</td>
<td>9.0</td>
<td>0.29</td>
</tr>
<tr>
<td>3</td>
<td>7.6</td>
<td>0.2</td>
</tr>
</tbody>
</table>

Category 1, extension zones

For definitions of the zones, see Extension zones for articulated robots on page 14.

<table>
<thead>
<tr>
<th>Zone</th>
<th>wcp min (m)</th>
<th>wcp max (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0.85</td>
</tr>
<tr>
<td>1</td>
<td>0.85</td>
<td>1.7</td>
</tr>
<tr>
<td>2</td>
<td>1.7</td>
<td>max reach</td>
</tr>
</tbody>
</table>

Category 1, Axis 1

Extension zone 0, stopping distance and stopping time

Continues on next page
Extension zone 1, stopping distance and stopping time

Continues on next page
Extension zone 2, stopping distance and stopping time

![Graph of stopping distance and stopping time for IRB 7600]
Category 1, Axis 2

Extension zone 0, stopping distance and stopping time

![Graph showing stopping distance and time for different speeds and mass ratios.](image-url)

Continued
Extension zone 1, stopping distance and stopping time
Extension zone 2, stopping distance and stopping time

Continues on next page
Category 1, Axis 3

Extension zone 0, stopping distance and stopping time
Extension zone 1, stopping distance and stopping time

Continues on next page
Extension zone 2, stopping distance and stopping time

---

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20.3 IRB 7600 2.80 m 340 kg

Category 0

The following table describes the stopping distance and time for category 0 emergency stop at max speed, with the arm stretched out to the maximum with maximum load. All results are from tests on one moving axis.

<table>
<thead>
<tr>
<th>Axis</th>
<th>Distance (degrees)</th>
<th>Stop time (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>31.1</td>
<td>0.71</td>
</tr>
<tr>
<td>2</td>
<td>12.9</td>
<td>0.37</td>
</tr>
<tr>
<td>3</td>
<td>9.0</td>
<td>0.22</td>
</tr>
</tbody>
</table>

Category 1, extension zones

For definitions of the zones, see Extension zones for articulated robots on page 14.

<table>
<thead>
<tr>
<th>Zone</th>
<th>wcp min (m)</th>
<th>wcp max (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0.932</td>
</tr>
<tr>
<td>1</td>
<td>0.932</td>
<td>1.865</td>
</tr>
<tr>
<td>2</td>
<td>1.865</td>
<td>max reach</td>
</tr>
</tbody>
</table>

Category 1, Axis 1

Extension zone 0, stopping distance and stopping time

---

Continues on next page
Extension zone 1, stopping distance and stopping time

Continues on next page
Extension zone 2, stopping distance and stopping time

![Graph showing stopping distance and time vs velocity](image)

Continued
Category 1, Axis 2

Extension zone 0, stopping distance and stopping time

![Graph showing stopping distance and stopping time for different speeds and mass ratios.](image)

Continued
Extension zone 1, stopping distance and stopping time

![Graph showing stopping distance and time vs. velocity](image)

Continued
Extension zone 2, stopping distance and stopping time
Category 1, Axis 3

Extension zone 0, stopping distance and stopping time

Continues on next page
Extension zone 1, stopping distance and stopping time
Extension zone 2, stopping distance and stopping time

![Graphs showing stopping distance and stopping time for different masses (m=100%, m=66%, m=33%).]
Category 0

The following table describes the stopping distance and time for category 0 emergency stop at max speed, with the arm stretched out to the maximum with maximum load. All results are from tests on one moving axis.

<table>
<thead>
<tr>
<th>Axis</th>
<th>Distance (degrees)</th>
<th>Stop time (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>33.0</td>
<td>0.78</td>
</tr>
<tr>
<td>2</td>
<td>9.0</td>
<td>0.29</td>
</tr>
<tr>
<td>3</td>
<td>8.4</td>
<td>0.22</td>
</tr>
</tbody>
</table>

Category 1, extension zones

For definitions of the zones, see Extension zones for articulated robots on page 14.

<table>
<thead>
<tr>
<th>Zone</th>
<th>wcp min (m)</th>
<th>wcp max (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>1.015</td>
</tr>
<tr>
<td>1</td>
<td>1.015</td>
<td>2.03</td>
</tr>
<tr>
<td>2</td>
<td>2.03</td>
<td>max reach</td>
</tr>
</tbody>
</table>

Category 1, Axis 1

Extension zone 0, stopping distance and stopping time

Continues on next page
Extension zone 1, stopping distance and stopping time
Extension zone 2, stopping distance and stopping time

Continues on next page
Category 1, Axis 2

Extension zone 0, stopping distance and stopping time
Extension zone 1, stopping distance and stopping time

![Graphs showing stopping distance and time for different speeds and mass levels.](image-url)
Extension zone 2, stopping distance and stopping time
Category 1, Axis 3

Extension zone 0, stopping distance and stopping time

![Graphs showing stopping distance and time](image-url)
Extension zone 1, stopping distance and stopping time

![Graph showing stopping distance and time vs. velocity for different mass percentages.](image-url)

Continued
Extension zone 2, stopping distance and stopping time

![Graph 1: Stopping Distance vs Velocity](image1)

![Graph 2: Stopping Time vs Velocity](image2)
20.5 IRB 7600 3.50 m 150 kg

Category 0

The following table describes the stopping distance and time for category 0 emergency stop at max speed, with the arm stretched out to the maximum with maximum load. All results are from tests on one moving axis.

<table>
<thead>
<tr>
<th>Axis</th>
<th>Distance (degrees)</th>
<th>Stop time (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>47.1</td>
<td>0.85</td>
</tr>
<tr>
<td>2</td>
<td>11.5</td>
<td>0.32</td>
</tr>
<tr>
<td>3</td>
<td>8.8</td>
<td>0.22</td>
</tr>
</tbody>
</table>

Category 1, extension zones

For definitions of the zones, see Extension zones for articulated robots on page 14.

<table>
<thead>
<tr>
<th>Zone</th>
<th>wcp min (m)</th>
<th>wcp max (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>1.167</td>
</tr>
<tr>
<td>1</td>
<td>1.167</td>
<td>2.333</td>
</tr>
<tr>
<td>2</td>
<td>2.333</td>
<td>max reach</td>
</tr>
</tbody>
</table>

Category 1, Axis 1

Extension zone 0, stopping distance and stopping time

Continues on next page
Extension zone 1, stopping distance and stopping time
Extension zone 2, stopping distance and stopping time

![Graph of stopping distance and time vs. velocity for different masses (100%, 66%, 33%) for IRB 7600 robot.](image)
Category 1, Axis 2

Extension zone 0, stopping distance and stopping time

---

Continues on next page
Extension zone 1, stopping distance and stopping time

![Graph showing stopping distance and time vs. velocity]

Continued
Extension zone 2, stopping distance and stopping time
Category 1, Axis 3

Extension zone 0, stopping distance and stopping time
Extension zone 1, stopping distance and stopping time

![Graph showing stopping distance and time for different speeds and masses.]

*Continued*
Extension zone 2, stopping distance and stopping time

![Graph showing stopping distance and time vs. velocity for different mass ratios m=100%, m=66%, m=33%]
20.6 IRB 7600 LeanID 2.55 m 390 kg

The following table describes the stopping distance and time for category 0 emergency stop at max speed, with the arm stretched out to the maximum with maximum load. All results are from tests on one moving axis.

<table>
<thead>
<tr>
<th>Axis</th>
<th>Distance (degrees)</th>
<th>Stop time (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>27.5</td>
<td>0.63</td>
</tr>
<tr>
<td>2</td>
<td>10.3</td>
<td>0.29</td>
</tr>
<tr>
<td>3</td>
<td>6.8</td>
<td>0.17</td>
</tr>
</tbody>
</table>

Category 1, extension zones

For definitions of the zones, see Extension zones for articulated robots on page 14.

<table>
<thead>
<tr>
<th>Zone</th>
<th>wcp min (m)</th>
<th>wcp max (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0.85</td>
</tr>
<tr>
<td>1</td>
<td>0.85</td>
<td>1.7</td>
</tr>
<tr>
<td>2</td>
<td>1.7</td>
<td>max reach</td>
</tr>
</tbody>
</table>

Category 1, Axis 1

Extension zone 0, stopping distance and stopping time...
Extension zone 1, stopping distance and stopping time

Continues on next page
Extension zone 2, stopping distance and stopping time

![Graph showing stopping distances and times for different masses (m=100%, m=66%, m=33%) against speed (v [m/s]).]

Continued
Category 1, Axis 2

Extension zone 0, stopping distance and stopping time

![Graph showing stopping distance and time vs. velocity](image)

Continued
Extension zone 1, stopping distance and stopping time

![Graph 1: Plane angle (°) vs. Velocity (m/s)]

![Graph 2: Time (s) vs. Velocity (m/s)]
Extension zone 2, stopping distance and stopping time

![Graph of stopping distance and time vs. speed]

---

Continues on next page
Category 1, Axis 3

Extension zone 0, stopping distance and stopping time

![Graph showing stopping distance and stopping time for different mass loadings (m=100%, m=66%, m=33%). The graphs display the relationship between velocity (v [m/s]) and angular displacement (\(\Phi_\theta\) [°]) and time (t [s]) for various masses.](image)
Extension zone 1, stopping distance and stopping time
Extension zone 2, stopping distance and stopping time

![Graphs showing stopping distance and time for different speeds and masses.](image-url)
20.7 IRB 7600 LeanID 2.8 m 320 kg

Category 0

The following table describes the stopping distance and time for category 0 emergency stop at max speed, with the arm stretched out to the maximum with maximum load. All results are from tests on one moving axis.

<table>
<thead>
<tr>
<th>Axis</th>
<th>Distance (degrees)</th>
<th>Stop time (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>28.3</td>
<td>0.66</td>
</tr>
<tr>
<td>2</td>
<td>10.7</td>
<td>0.32</td>
</tr>
<tr>
<td>3</td>
<td>7.2</td>
<td>0.17</td>
</tr>
</tbody>
</table>

Category 1, extension zones

For definitions of the zones, see Extension zones for articulated robots on page 14.

<table>
<thead>
<tr>
<th>Zone</th>
<th>wcp min (m)</th>
<th>wcp max (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0.932</td>
</tr>
<tr>
<td>1</td>
<td>0.932</td>
<td>1.865</td>
</tr>
<tr>
<td>2</td>
<td>1.865</td>
<td>max reach</td>
</tr>
</tbody>
</table>

Category 1, Axis 1

Extension zone 0, stopping distance and stopping time

Contines on next page
Extension zone 1, stopping distance and stopping time
Extension zone 2, stopping distance and stopping time

![Graphs showing stopping distances and times for different speeds and masses.](image-url)
Category 1, Axis 2
Extension zone 0, stopping distance and stopping time

\begin{center}
\begin{tikzpicture}
\begin{axis}[
    title={\(\Phi_s\) [\(^\circ\)]},
    xlabel={\(v\) [m/s]},
    ylabel={\(\Phi_s\) [\(^\circ\)]},
    xmin=0, xmax=2.5,
    ymin=0, ymax=12,
    xtick={0,0.5,1,1.5,2,2.5},
    ytick={0,2,4,6,8,10,12},
    legend style={at={(0.5,0.96)},anchor=north},
   legend image code/.code={
    
    },
]
\addlegendimage{red,mark=none,thick}
\addlegendentry{m=100%}
\addlegendimage{green,mark=none,thick}
\addlegendentry{m=66%}
\addlegendimage{blue,mark=none,thick}
\addlegendentry{m=33%}
\end{axis}
\end{tikzpicture}
\begin{tikzpicture}
\begin{axis}[
    title={\(t\) [s]},
    xlabel={\(v\) [m/s]},
    ylabel={\(t\) [s]},
    xmin=0, xmax=2.5,
    ymin=0, ymax=0.5,
    xtick={0,0.5,1,1.5,2,2.5},
    ytick={0,0.1,0.2,0.3,0.4},
    legend style={at={(0.5,0.96)},anchor=north},
   legend image code/.code={
    
    },
]
\addlegendimage{red,mark=none,thick}
\addlegendentry{m=100%}
\addlegendimage{green,mark=none,thick}
\addlegendentry{m=66%}
\addlegendimage{blue,mark=none,thick}
\addlegendentry{m=33%}
\end{axis}
\end{tikzpicture}
\end{center}
Extension zone 1, stopping distance and stopping time
Extension zone 2, stopping distance and stopping time

Continues on next page
Category 1, Axis 3

Extension zone 0, stopping distance and stopping time

![Graph 1: Phi vs. v](image1)

![Graph 2: t vs. v](image2)

Continues on next page
Extension zone 1, stopping distance and stopping time

![Graph 1: $P_h$ vs. $v$](image1)

![Graph 2: $t$ vs. $v$](image2)
Extension zone 2, stopping distance and stopping time

![Graph showing stopping distances and times for different load factors m=100%, m=66%, and m=33% against velocity v in m/s.](image)
Category 0

The following table describes the stopping distance and time for category 0 emergency stop at max speed, with the arm stretched out to the maximum with maximum load. All results are from tests on one moving axis.

<table>
<thead>
<tr>
<th>Axis</th>
<th>Distance (degrees)</th>
<th>Stop time (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>30.1</td>
<td>0.71</td>
</tr>
<tr>
<td>2</td>
<td>8.4</td>
<td>0.27</td>
</tr>
<tr>
<td>3</td>
<td>6.7</td>
<td>0.17</td>
</tr>
</tbody>
</table>

Category 1, extension zones

For definitions of the zones, see Extension zones for articulated robots on page 14.

<table>
<thead>
<tr>
<th>Zone</th>
<th>wcp min (m)</th>
<th>wcp max (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>1.015</td>
</tr>
<tr>
<td>1</td>
<td>1.015</td>
<td>2.03</td>
</tr>
<tr>
<td>2</td>
<td>2.03</td>
<td>max reach</td>
</tr>
</tbody>
</table>

Category 1, Axis 1

Extension zone 0, stopping distance and stopping time
Extension zone 1, stopping distance and stopping time
Extension zone 2, stopping distance and stopping time

![Graph showing stopping distance and time for different mass percentages.](image)

Continued
Category 1, Axis 2

Extension zone 0, stopping distance and stopping time

Continues on next page
Extension zone 1, stopping distance and stopping time

![Graph showing stopping distance and time vs. velocity]

Continued
Extension zone 2, stopping distance and stopping time

Continues on next page
Category 1, Axis 3

Extension zone 0, stopping distance and stopping time

![Graph of stopping distance and stopping time](image)
Extension zone 1, stopping distance and stopping time

![Graph showing stopping distance and time against velocity]

Continued
Extension zone 2, stopping distance and stopping time

![Graphs showing stopping distance and time for different mass ratios (m=100%, m=66%, m=33%) vs. velocity (v) in m/s.](image)
Category 0

The following table describes the stopping distance and time for category 0 emergency stop at max speed, with the arm stretched out to the maximum with maximum load. All results are from tests on one moving axis.

<table>
<thead>
<tr>
<th>Axis</th>
<th>Distance (degrees)</th>
<th>Stop time (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>44.4</td>
<td>1.31</td>
</tr>
<tr>
<td>2</td>
<td>11.4</td>
<td>0.32</td>
</tr>
<tr>
<td>3</td>
<td>13.0</td>
<td>0.37</td>
</tr>
</tbody>
</table>

Category 1, extension zones

For definitions of the zones, see *Extension zones for articulated robots on page 14.*

<table>
<thead>
<tr>
<th>Zone</th>
<th>wcp min (m)</th>
<th>wcp max (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>1.169</td>
</tr>
<tr>
<td>1</td>
<td>1.169</td>
<td>2.338</td>
</tr>
<tr>
<td>2</td>
<td>2.338</td>
<td>max reach</td>
</tr>
</tbody>
</table>

Category 1, Axis 1

Extension zone 0, stopping distance and stopping time
Extension zone 1, stopping distance and stopping time
Extension zone 2, stopping distance and stopping time

![Graphs showing stopping distance and time vs. speed for different load conditions.](Image)

Continues on next page
Category 1, Axis 2

Extension zone 0, stopping distance and stopping time

![Graphs showing stopping distance and time vs. velocity for different mass load ratios](image-url)
Extension zone 1, stopping distance and stopping time

[Graphs showing stopping distance and stopping time as functions of velocity for different mass percentages]
Extension zone 2, stopping distance and stopping time

---

Continues on next page
Category 1, Axis 3

Extension zone 0, stopping distance and stopping time
Extension zone 1, stopping distance and stopping time

![Graphs showing stopping distance and time for different speeds and masses](image-url)
Extension zone 2, stopping distance and stopping time

![Graph of stopping distance vs. velocity](image1)

![Graph of stopping time vs. velocity](image2)
21.2 IRB 8700 4.20 m 550 kg

Category 0

The following table describes the stopping distance and time for category 0 emergency stop at max speed, with the arm stretched out to the maximum with maximum load. All results are from tests on one moving axis.

<table>
<thead>
<tr>
<th>Axis</th>
<th>Distance (degrees)</th>
<th>Stop time (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>44.4</td>
<td>1.33</td>
</tr>
<tr>
<td>2</td>
<td>10.0</td>
<td>0.27</td>
</tr>
<tr>
<td>3</td>
<td>14.4</td>
<td>0.44</td>
</tr>
</tbody>
</table>

Category 1, extension zones

For definitions of the zones, see Extension zones for articulated robots on page 14.

<table>
<thead>
<tr>
<th>Zone</th>
<th>wcp min (m)</th>
<th>wcp max (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>1.399</td>
</tr>
<tr>
<td>1</td>
<td>1.399</td>
<td>2.798</td>
</tr>
<tr>
<td>2</td>
<td>2.798</td>
<td>max reach</td>
</tr>
</tbody>
</table>

Category 1, Axis 1

Extension zone 0, stopping distance and stopping time
Extension zone 1, stopping distance and stopping time

Continues on next page
Extension zone 2, stopping distance and stopping time
Category 1, Axis 2

Extension zone 0, stopping distance and stopping time

![Graph 1: Phi vs. v](image)

![Graph 2: t vs. v](image)
Extension zone 1, stopping distance and stopping time

![Graph](image1)

![Graph](image2)
Extension zone 2, stopping distance and stopping time
Category 1, Axis 3

Extension zone 0, stopping distance and stopping time
Extension zone 1, stopping distance and stopping time

![Graph showing stopping distance and time against speed for different mass fractions](image-url)
Extension zone 2, stopping distance and stopping time

![Graph](image1.png)

![Graph](image2.png)
The following table describes the stopping distance and time for category 0 emergency stop at max speed, with the arm stretched out to the maximum with maximum load. All results are from tests on one moving axis.

<table>
<thead>
<tr>
<th>Axis</th>
<th>Distance (degrees)</th>
<th>Stop time (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>44.4</td>
<td>1.19</td>
</tr>
<tr>
<td>2</td>
<td>10.1</td>
<td>0.27</td>
</tr>
<tr>
<td>3</td>
<td>9.6</td>
<td>0.25</td>
</tr>
</tbody>
</table>

Category 1, extension zones

For definitions of the zones, see Extension zones for articulated robots on page 14.

<table>
<thead>
<tr>
<th>Zone</th>
<th>wcp min (m)</th>
<th>wcp max (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>1.169</td>
</tr>
<tr>
<td>1</td>
<td>1.169</td>
<td>2.338</td>
</tr>
<tr>
<td>2</td>
<td>2.338</td>
<td>max reach</td>
</tr>
</tbody>
</table>

Category 1, Axis 1

Extension zone 0, stopping distance and stopping time
Extension zone 1, stopping distance and stopping time
Extension zone 2, stopping distance and stopping time

![Graphs showing stopping distance and time for different mass ratios (m=100%, m=66%, m=33%) at varying velocities (v in m/s).]

Continues on next page
Category 1, Axis 2

Extension zone 0, stopping distance and stopping time
Extension zone 1, stopping distance and stopping time

Continued
Extension zone 2, stopping distance and stopping time
Category 1, Axis 3

Extension zone 0, stopping distance and stopping time

Continued on next page
Extension zone 1, stopping distance and stopping time

![Graph showing stopping distance and time for different masses](image)

Continues on next page
Extension zone 2, stopping distance and stopping time

![Graph 1: \( \phi_i \) vs. \( v \)](image1)

- \( m = 100\% \)
- \( m = 66\% \)
- \( m = 33\% \)

![Graph 2: \( t \) vs. \( v \)](image2)

- \( m = 100\% \)
- \( m = 66\% \)
- \( m = 33\% \)
Category 0

The following table describes the stopping distance and time for category 0 emergency stop at max speed, with the arm stretched out to the maximum with maximum load. All results are from tests on one moving axis.

<table>
<thead>
<tr>
<th>Axis</th>
<th>Distance (degrees)</th>
<th>Stop time (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>44.4</td>
<td>1.26</td>
</tr>
<tr>
<td>2</td>
<td>9.5</td>
<td>0.25</td>
</tr>
<tr>
<td>3</td>
<td>12.0</td>
<td>0.34</td>
</tr>
</tbody>
</table>

Category 1, extension zones

For definitions of the zones, see Extension zones for articulated robots on page 14.

<table>
<thead>
<tr>
<th>Zone</th>
<th>wcp min (m)</th>
<th>wcp max (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>1.399</td>
</tr>
<tr>
<td>1</td>
<td>1.399</td>
<td>2.798</td>
</tr>
<tr>
<td>2</td>
<td>2.798</td>
<td>max reach</td>
</tr>
</tbody>
</table>

Category 1, Axis 1

Extension zone 0, stopping distance and stopping time
Extension zone 1, stopping distance and stopping time

Continues on next page
Extension zone 2, stopping distance and stopping time

Continued
Category 1, Axis 2

Extension zone 0, stopping distance and stopping time

![Graph showing stopping distance and time versus velocity for different mass percentages.](image)
Extension zone 1, stopping distance and stopping time

![Graph 1: \( \Phi_i \) vs. \( v \)](image)

- Red line: \( m=100\% \)
- Green line: \( m=66\% \)
- Blue line: \( m=33\% \)

![Graph 2: \( t \) vs. \( v \)](image)

- Red line: \( m=100\% \)
- Green line: \( m=66\% \)
- Blue line: \( m=33\% \)
Extension zone 2, stopping distance and stopping time

Continues on next page
Category 1, Axis 3

Extension zone 0, stopping distance and stopping time

![Graph showing stopping distance and time vs. velocity]

Continued
Extension zone 1, stopping distance and stopping time

![Graph showing stopping distance and time vs. velocity for different mass percentages.]

Continues on next page
Extension zone 2, stopping distance and stopping time

![Graph showing stopping distance and time vs. velocity]
22 IRB 460

22.1 IRB 460 2.4 m 110 kg

Category 0

The following table describes the stopping distance and time for category 0 emergency stop at max speed, with the arm stretched out to the maximum with maximum load. All results are from tests on one moving axis.

<table>
<thead>
<tr>
<th>Axis</th>
<th>Distance (degrees)</th>
<th>Stop time (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>41.5</td>
<td>0.49</td>
</tr>
<tr>
<td>2</td>
<td>14.6</td>
<td>0.17</td>
</tr>
<tr>
<td>3</td>
<td>13.6</td>
<td>0.15</td>
</tr>
</tbody>
</table>

Category 1, extension zones

For definitions of the zones, see Extension zones for articulated robots on page 14.

<table>
<thead>
<tr>
<th>Zone</th>
<th>wcp min (m)</th>
<th>wcp max (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0.889</td>
</tr>
<tr>
<td>1</td>
<td>0.889</td>
<td>1.778</td>
</tr>
<tr>
<td>2</td>
<td>1.778</td>
<td>max reach</td>
</tr>
</tbody>
</table>

Category 1, Axis 1

Extension zone 0, stopping distance and stopping time

![Graph showing stopping distance and time for category 0 emergency stop.]

Continues on next page
Extension zone 1, stopping distance and stopping time
Extension zone 2, stopping distance and stopping time

\[ P_h [\text{m}] \]

\[ t [\text{s}] \]

\[ v [\text{m/s}] \]

\[ m = 100\% \]
\[ m = 66\% \]
\[ m = 33\% \]
Category 1, Axis 2

Extension zone 0, stopping distance and stopping time
Extension zone 1, stopping distance and stopping time

![Graph 1: Ph(t)](image1)

![Graph 2: t[s]](image2)
Extension zone 2, stopping distance and stopping time

![Graph showing stopping distance vs. velocity](image)

![Graph showing stopping time vs. velocity](image)
Category 1, Axis 3

Extension zone 0, stopping distance and stopping time

[Graphs showing stopping distances and times for different speeds and masses]

Continued
Extension zone 1, stopping distance and stopping time

Continued
Extension zone 2, stopping distance and stopping time

- For IRB 460 2.4 m 110 kg

Graphs showing the relationship between velocity (v [m/s]) and stopping distance (Ph [m]) and stopping time (t [s]) for different mass ratios (m=100%, m=66%, m=33%).
23 IRB 660

23.1 IRB 660 3.15 m 180 kg

Category 0

The following table describes the stopping distance and time for category 0 emergency stop at max speed, with the arm stretched out to the maximum with maximum load. All results are from tests on one moving axis.

<table>
<thead>
<tr>
<th>Axis</th>
<th>Distance (degrees)</th>
<th>Stop time (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>64.4</td>
<td>0.9</td>
</tr>
<tr>
<td>2</td>
<td>32.6</td>
<td>0.39</td>
</tr>
<tr>
<td>3</td>
<td>27.0</td>
<td>0.29</td>
</tr>
</tbody>
</table>

Category 1, extension zones

For definitions of the zones, see *Extension zones for articulated robots on page 14.*

<table>
<thead>
<tr>
<th>Zone</th>
<th>wcp min (m)</th>
<th>wcp max (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>1.148</td>
</tr>
<tr>
<td>1</td>
<td>1.148</td>
<td>2.297</td>
</tr>
<tr>
<td>2</td>
<td>2.297</td>
<td>max reach</td>
</tr>
</tbody>
</table>

Category 1, Axis 1

Extension zone 0, stopping distance and stopping time

![Graph showing stopping distance and time for category 0 emergency stop]
Extension zone 1, stopping distance and stopping time

Continues on next page
Extension zone 2, stopping distance and stopping time

![Graph 1: Ph vs. v (m/s)](image1)

![Graph 2: t vs. v (m/s)](image2)

Continues on next page
Category 1, Axis 2

Extension zone 0, stopping distance and stopping time

Continues on next page
Extension zone 1, stopping distance and stopping time
Extension zone 2, stopping distance and stopping time
Category 1, Axis 3

Extension zone 0, stopping distance and stopping time

---

Continues on next page
Extension zone 1, stopping distance and stopping time

![Graphs showing stopping distance and time for different mass percentages.](image)
Extension zone 2, stopping distance and stopping time

Graphs showing the relationship between velocity ($v$ [m/s]) and stopping distance ($P_h$ [m]) and stopping time ($t$ [s]) for different load masses ($m=100\%, m=66\%, m=33\%)$. The graphs indicate how the stopping distance and time change with velocity for each load mass.
23.2 IRB 660 3.15 m 250 kg

Category 0

The following table describes the stopping distance and time for category 0 emergency stop at max speed, with the arm stretched out to the maximum with maximum load. All results are from tests on one moving axis.

<table>
<thead>
<tr>
<th>Axis</th>
<th>Distance (degrees)</th>
<th>Stop time (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>43.1</td>
<td>0.78</td>
</tr>
<tr>
<td>2</td>
<td>23.2</td>
<td>0.37</td>
</tr>
<tr>
<td>3</td>
<td>21.6</td>
<td>0.32</td>
</tr>
</tbody>
</table>

Category 1, extension zones

For definitions of the zones, see Extension zones for articulated robots on page 14.

<table>
<thead>
<tr>
<th>Zone</th>
<th>wcp min (m)</th>
<th>wcp max (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>1.148</td>
</tr>
<tr>
<td>1</td>
<td>1.148</td>
<td>2.297</td>
</tr>
<tr>
<td>2</td>
<td>2.297</td>
<td>max reach</td>
</tr>
</tbody>
</table>

Category 1, Axis 1

Extension zone 0, stopping distance and stopping time
Extension zone 1, stopping distance and stopping time

Continues on next page
Extension zone 2, stopping distance and stopping time

![Graphs showing stopping distance and time vs. velocity](image)

Continued
Category 1, Axis 2

Extension zone 0, stopping distance and stopping time

![Graph of stopping distance and time vs. velocity](image-url)
Extension zone 1, stopping distance and stopping time

![Graph showing stopping distance and time vs. velocity for different masses.](image-url)
Extension zone 2, stopping distance and stopping time

[Graph showing stopping distance and stopping time for different masses and velocities]

Continues on next page
Category 1, Axis 3

Extension zone 0, stopping distance and stopping time

Continues on next page
Extension zone 1, stopping distance and stopping time

![Graph showing stopping distances and times for different masses](image)

---

Product specification - Robot stopping distances according to ISO 10218-1

Continues on next page
Extension zone 2, stopping distance and stopping time

![Graph 1](image1)

![Graph 2](image2)
The following table describes the stopping distance and time for category 0 emergency stop at max speed, with the arm stretched out to the maximum with maximum load. All results are from tests on one moving axis.

<table>
<thead>
<tr>
<th>Axis</th>
<th>Distance (degrees)</th>
<th>Stop time (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>40.7</td>
<td>0.89</td>
</tr>
<tr>
<td>2</td>
<td>24.4</td>
<td>0.54</td>
</tr>
<tr>
<td>3</td>
<td>26.9</td>
<td>0.56</td>
</tr>
</tbody>
</table>

Category 1, extension zones

For definitions of the zones, see Extension zones for articulated robots on page 14.

<table>
<thead>
<tr>
<th>Zone</th>
<th>wcp min (m)</th>
<th>wcp max (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>1.17</td>
</tr>
<tr>
<td>1</td>
<td>1.17</td>
<td>2.34</td>
</tr>
<tr>
<td>2</td>
<td>2.34</td>
<td>max reach</td>
</tr>
</tbody>
</table>

Category 1, Axis A1

Extension zone 0, stopping distance and stopping time

Continues on next page
Extension zone 1, stopping distance and stopping time
Extension zone 2, stopping distance and stopping time

![Graph of stopping distance and stopping time vs. velocity]

Continues on next page
Category 1, Axis A2

Extension zone 0, stopping distance and stopping time
Extension zone 1, stopping distance and stopping time

![Graphs showing stopping distance vs. velocity for different mass loads.](image)
Extension zone 2, stopping distance and stopping time
Category 1, Axis A3

Extension zone 0, stopping distance and stopping time

![Graph showing stopping distance and stopping time for different mass ratios m=100%, m=66%, and m=33% as a function of velocity v [m/s].]
Extension zone 1, stopping distance and stopping time

\[ P_h \text{ [°]} \]

\[ t \text{ [s]} \]

\[ v \text{ [m/s]} \]

\[ m=100\% \]
\[ m=66\% \]
\[ m=33\% \]
Extension zone 2, stopping distance and stopping time

![Graph showing stopping distance and stopping time for different masses](image1)

![Graph showing stopping distance and stopping time for different masses](image2)
Category 0

The following table describes the stopping distance and time for category 0 emergency stop at max speed, with the arm stretched out to the maximum with maximum load. All results are from tests on one moving axis.

<table>
<thead>
<tr>
<th>Axis</th>
<th>Distance (degrees)</th>
<th>Stop time (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>40.2</td>
<td>0.83</td>
</tr>
<tr>
<td>2</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>3</td>
<td>26.4</td>
<td>0.49</td>
</tr>
</tbody>
</table>

Category 1, extension zones

For definitions of the zones, see Extension zones for articulated robots on page 14.

<table>
<thead>
<tr>
<th>Zone</th>
<th>wcp min (m)</th>
<th>wcp max (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>1.168</td>
</tr>
<tr>
<td>1</td>
<td>1.168</td>
<td>2.337</td>
</tr>
<tr>
<td>2</td>
<td>2.337</td>
<td>max reach</td>
</tr>
</tbody>
</table>

Category 1, Axis 1

Extension zone 0, stopping distance and stopping time
Extension zone 1, stopping distance and stopping time

Continues on next page
Extension zone 2, stopping distance and stopping time

![Graph showing stopping distance and stopping time for IRB 760](image)

Continues on next page
Category 1, Axis 2

Extension zone 0, stopping distance and stopping time

![Graph showing stopping distances and times for different masses](image-url)
Extension zone 1, stopping distance and stopping time

![Graphs showing stopping distance and time for different mass loads](image)

Continued
Extension zone 2, stopping distance and stopping time

Continued on next page
Category 1, Axis 3

Extension zone 0, stopping distance and stopping time

Continues on next page
Extension zone 1, stopping distance and stopping time

[Graph showing stopping distance vs. velocity for different mass loadings (m=100%, m=66%, m=33%).]
Extension zone 2, stopping distance and stopping time
The following table describes the stopping distance and time for category 0 emergency stop at max speed, with the arm stretched out to the maximum with maximum load.

<table>
<thead>
<tr>
<th>Protection type/variant</th>
<th>Distance (meters)</th>
<th>Stop time (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard</td>
<td>0.57</td>
<td>0.18</td>
</tr>
<tr>
<td>Wash down</td>
<td>0.56</td>
<td>0.18</td>
</tr>
<tr>
<td>3AXES</td>
<td>0.57</td>
<td>0.17</td>
</tr>
</tbody>
</table>
Category 1, Standard

Stopping distance and stopping time

Continues on next page
Category 1, Wash Down

Stopping distance and stopping time

Continues on next page
Category 1, 3AXES

Stopping distance and stopping time
25.2 IRB 360 1.13 m 1 kg

Category 0

The following table describes the stopping distance and time for category 0 emergency stop at max speed, with the arm stretched out to the maximum with maximum load.

<table>
<thead>
<tr>
<th>Protection type/variant</th>
<th>Distance (meters)</th>
<th>Stop time (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard</td>
<td>0.69</td>
<td>0.19</td>
</tr>
<tr>
<td>Wash down</td>
<td>0.69</td>
<td>0.19</td>
</tr>
<tr>
<td>3AXES</td>
<td>0.73</td>
<td>0.18</td>
</tr>
<tr>
<td>Stainless</td>
<td>0.67</td>
<td>0.19</td>
</tr>
</tbody>
</table>
Category 1, Standard
Stopping distance and stopping time
Category 1, Wash Down

Stopping distance and stopping time

Continues on next page
Category 1, 3AXES

Stopping distance and stopping time

[Graphs showing stopping distance and stopping time for different speeds and distances.]
Category 1, Stainless

Stopping distance and stopping time
The following table describes the stopping distance and time for category 0 emergency stop at max speed, with the arm stretched out to the maximum with maximum load.

<table>
<thead>
<tr>
<th>Protection type/variant</th>
<th>Distance (meters)</th>
<th>Stop time (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard</td>
<td>0.65</td>
<td>0.21</td>
</tr>
<tr>
<td>Wash down</td>
<td>0.65</td>
<td>0.21</td>
</tr>
<tr>
<td>3AXES</td>
<td>0.62</td>
<td>0.20</td>
</tr>
<tr>
<td>Stainless</td>
<td>0.64</td>
<td>0.22</td>
</tr>
</tbody>
</table>
Category 1, Standard

Stopping distance and stopping time

Continues on next page
Category 1, Wash Down

Stopping distance and stopping time
Category 1, 3AXES

Stopping distance and stopping time

Continued
Category 1, Stainless

Stopping distance and stopping time
## Category 0

The following table describes the stopping distance and time for category 0 emergency stop at max speed, with the arm stretched out to the maximum with maximum load.

<table>
<thead>
<tr>
<th>Protection type/variant</th>
<th>Distance (meters)</th>
<th>Stop time (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard</td>
<td>0.65</td>
<td>0.33</td>
</tr>
</tbody>
</table>
Category 1, Standard

Stopping distance and stopping time

![Graph showing stopping distance and stopping time for different speeds and load conditions.](Image)
Category 0

The following table describes the stopping distance and time for category 0 emergency stop at max speed, with the arm stretched out to the maximum with maximum load.

<table>
<thead>
<tr>
<th>Protection type/variant</th>
<th>Distance (meters)</th>
<th>Stop time (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard</td>
<td>0.90</td>
<td>0.22</td>
</tr>
</tbody>
</table>
Category 1, Standard

Stopping distance and stopping time
25.6 IRB 360 1.6 m 6 kg

Category 0

The following table describes the stopping distance and time for category 0 emergency stop at max speed, with the arm stretched out to the maximum with maximum load.

<table>
<thead>
<tr>
<th>Protection type/variant</th>
<th>Distance (meters)</th>
<th>Stop time (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard</td>
<td>0.93</td>
<td>0.36</td>
</tr>
</tbody>
</table>
Category 1, Standard

Stopping distance and stopping time
## Category 0

The following table describes the stopping distance and time for category 0 emergency stop at max speed, with the arm stretched out to the maximum with maximum load.

<table>
<thead>
<tr>
<th>Protection type/variant</th>
<th>Distance (meters)</th>
<th>Stop time (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard</td>
<td>0.55</td>
<td>0.25</td>
</tr>
</tbody>
</table>
Category 1, Standard

Stopping distance and stopping time

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26.1 IRB 365 0.8 m 1.5 kg

Continued
### 26.2 IRB 365 1.1 m 1.5 kg

**Category 0**

The following table describes the stopping distance and time for category 0 emergency stop at max speed, with the arm stretched out to the maximum with maximum load.

<table>
<thead>
<tr>
<th>Protection type/variant</th>
<th>Distance (meters)</th>
<th>Stop time (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard</td>
<td>0.41</td>
<td>0.29</td>
</tr>
</tbody>
</table>

Continues on next page
Category 1, Standard

Stopping distance and stopping time

![Graph showing stopping distance and time for different masses](image)
The following table describes the stopping distance and time for category 0 emergency stop at max speed, with the arm stretched out to the maximum with maximum load.

<table>
<thead>
<tr>
<th>Protection type/variant</th>
<th>Distance (meters)</th>
<th>Stop time (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard</td>
<td>0.73</td>
<td>0.26</td>
</tr>
</tbody>
</table>
Category 1, Standard
Stopping distance and stopping time
27 IRB 390

27.1 IRB 390 1.3 m 10 kg

Category 0

The following table describes the stopping distance and time for category 0 emergency stop at max speed, with the arm stretched out to the maximum with maximum load.

<table>
<thead>
<tr>
<th>Protection type/variant</th>
<th>Distance (meters)</th>
<th>Stop time (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard</td>
<td>0.71</td>
<td>0.29</td>
</tr>
</tbody>
</table>

Continues on next page
Category 1, Standard

Stopping distance and stopping time
27.2 IRB 390 1.3 m 15 kg

Category 0

The following table describes the stopping distance and time for category 0 emergency stop at max speed, with the arm stretched out to the maximum with maximum load.

<table>
<thead>
<tr>
<th>Protection type/variant</th>
<th>Distance (meters)</th>
<th>Stop time (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard</td>
<td>0.72</td>
<td>0.28</td>
</tr>
</tbody>
</table>

Continues on next page
Category 1, Standard

Stopping distance and stopping time

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Product specification - Robot stopping distances according to ISO 10218-1

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Category 0, ARM

Stopping distance and stopping time
Category 0, PLATE

Stopping distance and stopping time

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Category 1, ARM

Stopping distance and stopping time

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Category 1, PLATE

Stopping distance and stopping time
28.2 A500_D1000

Category 0, ARM

Stopping distance and stopping time
Category 0, PLATE

Stopping distance and stopping time

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Category 1, ARM

Stopping distance and stopping time
Category 1, PLATE

Stopping distance and stopping time
28.3 A500_D1450

Category 0, ARM

Stopping distance and stopping time

### Graph

Graph showing the relationship between stopping time and speed for different load conditions.

- **Graph 1**: Relationship between stopping distance and speed for various load cases.
- **Graph 2**: Relationship between stopping time and speed for different load cases.

### Notes

- The graphs illustrate the stopping performance of the robot for different load conditions.
- The data is based on ISO 10218-1 standards.

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Stopping distance and stopping time

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Category 1, ARM

Stopping distance and stopping time

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Category 1, PLATE

Stopping distance and stopping time
Category 0, ARM

Stopping distance and stopping time
Category 0, PLATE

Stopping distance and stopping time

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Category 1, ARM

Stopping distance and stopping time

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Category 1, PLATE

Stopping distance and stopping time
Category 0, ARM

Stopping distance and stopping time
Category 0, PLATE

Stopping distance and stopping time
Category 1, ARM

Stopping distance and stopping time

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Category 1, PLATE

Stopping distance and stopping time

![Graph 1](image1)

![Graph 2](image2)
Category 0, INTERCH

Stopping distance and stopping time
Category 0, ARM

Stopping distance and stopping time

---

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Category 0, PLATE

Stopping distance and stopping time
Category 1, INTERCH

Stopping distance and stopping time

![Graph of stopping distance and time]

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Category 1, ARM

Stopping distance and stopping time

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Category 1, PLATE

Stopping distance and stopping time
29.2 B500_D1450

Category 0, INTERCH

Stopping distance and stopping time

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Category 0, ARM

Stopping distance and stopping time

![Graph showing stopping distance and stopping time for B500_D1450 ARM](image-url)
Category 0, PLATE

Stopping distance and stopping time
Category 1, INTERCH

Stopping distance and stopping time
Category 1, ARM

Stopping distance and stopping time

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Category 1, PLATE

Stopping distance and stopping time

![Graph showing stopping distance and time for different speeds and loads](image)

---

Continued
29.3 B750_D1450

Category 0, INTERCH

Stopping distance and stopping time

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Category 0, ARM

Stopping distance and stopping time

[Graphs showing stopping distances and times for different speeds]

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Category 0, PLATE

Stopping distance and stopping time

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Category 1, INTERCH

Stopping distance and stopping time

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Category 1, ARM

Stopping distance and stopping time
Category 1, PLATE

Stopping distance and stopping time
Category 0, INTERCH

Stopping distance and stopping time
Category 1, INTERCH

Stopping distance and stopping time

![Graph showing stopping distances and time for different speeds.](image-url)
30.2 C1000

Category 0, INTERCH

Stopping distance and stopping time
Category 1, INTERCH

Stopping distance and stopping time
31 IRBP D

31.1 D300_L1250_D1000

Category 0, INTERCH

Stopping distance and stopping time

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Category 0, ARM

Stopping distance and stopping time
Category 0, PLATE

Stopping distance and stopping time

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Category 1, INTERCH

Stopping distance and stopping time
Category 1, ARM

Stopping distance and stopping time

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Category 1, PLATE

Stopping distance and stopping time

![Graph showing stopping distance and stopping time for D300_L1250_D1000](image1)

![Graph showing stopping distance and stopping time for D300_L1250_D1000](image2)
31.2 D300_L1600_D1000

Category 0, INTERCH

Stopping distance and stopping time

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Category 0, ARM

Stopping distance and stopping time
Category 0, PLATE

Stopping distance and stopping time
Category 1, INTERCH

Stopping distance and stopping time

![Graph 1](image1)

![Graph 2](image2)
Category 1, ARM

Stopping distance and stopping time

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Stopping distance and stopping time
31.3 D600_L1600_D1000

Category 0, INTERCH

Stopping distance and stopping time

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Category 0, ARM

Stopping distance and stopping time

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Category 0, PLATE

Stopping distance and stopping time

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Category 1, INTERCH

Stopping distance and stopping time

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Category 1, ARM

Stopping distance and stopping time

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Category 1, PLATE

Stopping distance and stopping time
31.4 D600_L1600_D1200

Category 0, INTERCH

Stopping distance and stopping time

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Category 0, ARM

Stopping distance and stopping time

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Category 0, PLATE

Stopping distance and stopping time

![Graph showing stopping distance and stopping time]

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Category 1, INTERCH

Stopping distance and stopping time

[Graphs showing stopping distance and time as a function of speed]
Category 1, ARM

Stopping distance and stopping time
Category 1, PLATE

Stopping distance and stopping time
31.5 D600_L2000_D1000

Category 0, INTERCH

Stopping distance and stopping time

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Category 0, ARM

Stopping distance and stopping time
Category 0, PLATE

Stopping distance and stopping time
Category 1, INTERCH

Stopping distance and stopping time
Category 1, ARM

Stopping distance and stopping time

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Category 1, PLATE

Stopping distance and stopping time

[Graphs showing stopping distance and stopping time for different speeds and load conditions.]
Category 0, INTERCH

Stopping distance and stopping time

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Category 0, ARM

Stopping distance and stopping time

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Category 0, PLATE

Stopping distance and stopping time

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Category 1, INTERCH

Stopping distance and stopping time

![Graph showing stopping distance and stopping time for different speeds for different categories of vehicles.](image)
Category 1, ARM

Stopping distance and stopping time
Category 1, PLATE

Stopping distance and stopping time

![Graph 1](image1.png)

![Graph 2](image2.png)
Category 0, INTERCH

Stopping distance and stopping time

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Category 0, PLATE

Stopping distance and stopping time
Category 1, INTERCH

Stopping distance and stopping time

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Category 1, PLATE

Stopping distance and stopping time

![Graphs showing stopping distance and stopping time for IRBP K1000_D1200.](image-url)
32.2 K1000_D1400

Category 0, INTERCH

Stopping distance and stopping time

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Category 0, PLATE

Stopping distance and stopping time

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Category 1, INTERCH

Stopping distance and stopping time

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Category 1, PLATE

Stopping distance and stopping time

[Graphs showing stopping distances and times for different speeds.]
32.3 K300_D1000

Category 0, INTERCH

Stopping distance and stopping time

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Category 1, INTERCH

Stopping distance and stopping time

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Category 1, PLATE

Stopping distance and stopping time
Category 0, INTERCH

Stopping distance and stopping time

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Category 0, PLATE

Stopping distance and stopping time
Category 1, INTERCH

Stopping distance and stopping time
Category 1, PLATE

Stopping distance and stopping time

![Stopping distance and stopping time graph](image-url)
Category 0, INTERCH

Stopping distance and stopping time

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Category 0, PLATE

Stopping distance and stopping time
Category 1, INTERCH

Stopping distance and stopping time
Category 1, PLATE

Stopping distance and stopping time

![Graph showing stopping distance and time for different speeds.]

![Graph showing stopping distance and time for different speeds.]
Category 0, INTERCH

Stopping distance and stopping time

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Category 0, PLATE

Stopping distance and stopping time

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Category 1, INTERCH

Stopping distance and stopping time
Category 1, PLATE

Stopping distance and stopping time

![Graphs showing stopping distance and time for different speeds and configurations.]

NG00_D1_400 PLATE

5000 C0400 PLATE

NG00_D1_400 PLATE
Category 0, PLATE

Stopping distance and stopping time
Category 1, PLATE

Stopping distance and stopping time
33.2 L2000

Category 0, PLATE

Stopping distance and stopping time
Category 1, PLATE

Stopping distance and stopping time

[Graphs showing stopping distances for L2000]
33.3 L300

Category 0, PLATE

Stopping distance and stopping time

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33 IRBP L

33.3 L300

Continued

Category 1, PLATE

Stopping distance and stopping time
33.4 L5000

Category 0, PLATE

Stopping distance and stopping time

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Category 1, PLATE

Stopping distance and stopping time

[Graphs showing stopping distances and times for different speeds]
33.5 L600

Category 0, PLATE

Stopping distance and stopping time

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Category 1, PLATE

Stopping distance and stopping time

![Stopping distance graph](image1)

![Stopping time graph](image2)
Category 0, INTERCH

Stopping distance and stopping time

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Category 0, PLATE

Stopping distance and stopping time

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Category 1, INTERCH

Stopping distance and stopping time
Category 1, PLATE

Stopping distance and stopping time
Category 0, INTERCH

Stopping distance and stopping time
Category 0, PLATE

Stopping distance and stopping time
Category 1, INTERCH

Stopping distance and stopping time

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Category 1, PLATE

Stopping distance and stopping time

![Graph of stopping distance and stopping time](image-url)
### 34.3 R1000_L2000_D1000

**Category 0, INTERCH**

Stopping distance and stopping time

![Graph showing stopping distances and times for different scenarios.](image-url)
Category 0, PLATE

Stopping distance and stopping time

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Category 1, INTERCH

Stopping distance and stopping time
Category 1, PLATE

Stopping distance and stopping time

[Graphs showing stopping distance and stopping time for different speeds and load conditions]
34.4 R1000_L2000_D1200

Category 0, INTERCH

Stopping distance and stopping time

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Category 0, PLATE

Stopping distance and stopping time
Category 1, INTERCH

Stopping distance and stopping time

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Category 1, PLATE

Stopping distance and stopping time

![Graph showing stopping distance and stopping time for different speeds and accelerations.](image1)

![Graph showing stopping distance and stopping time for different speeds and accelerations.](image2)
Category 0, INTERCH

Stopping distance and stopping time

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Category 0, PLATE

Stopping distance and stopping time

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Category 1, INTERCH

Stopping distance and stopping time

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Category 1, PLATE

Stopping distance and stopping time

![Graph showing stopping distance and stopping time for different speeds and distances.](image)
34.6 R300_L1600_D1000

Category 0, INTERCH

Stopping distance and stopping time
Category 0, PLATE

Stopping distance and stopping time
Category 1, INTERCH

Stopping distance and stopping time

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Category 1, PLATE

Stopping distance and stopping time
Category 0, INTERCH

Stopping distance and stopping time

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Category 0, PLATE

Stopping distance and stopping time

[Graphs showing stopping distances and times for different speeds and conditions]

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Category 1, INTERCH

Stopping distance and stopping time

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Category 1, PLATE

Stopping distance and stopping time
Category 0, INTERCH

Stopping distance and stopping time

Continues on next page
Category 0, PLATE

Stopping distance and stopping time
Category 1, INTERCH

Stopping distance and stopping time
Category 1, PLATE

Stopping distance and stopping time

[Graphs showing stopping distance and stopping time for different conditions]
34.9 R600_L2000_D1000

Category 0, INTERCH

Stopping distance and stopping time

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Category 0, PLATE

Stopping distance and stopping time
Category 1, INTERCH

Stopping distance and stopping time
Category 1, PLATE

Stopping distance and stopping time
34.10 R600_L2000_D1200

Category 0, INTERCH

Stopping distance and stopping time

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Category 0, PLATE

Stopping distance and stopping time

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Category 1, INTERCH

Stopping distance and stopping time

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Category 1, PLATE

Stopping distance and stopping time

![Graph](image-url)
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