

Waze Beacons

Setup Guidelines

This document was written with the help of 3M engineers and have been thoroughly tested. Changing steps in these instructions or deviating from the materials listed here should be done carefully after consulting with qualified personnel and at your own risk. Please let the Waze team know if you plan to deviate at all from the following guidelines before performing the installation.

Deviating from these instructions (including the materials used, cleaning process or placement setup) may be harmful and/or affect the beacons' effectiveness

Beacon placement

Install beacons with the following conditions in mind:

- Beacons should be installed on the wall of the tunnel at the following heights:
 - **Optimal installation height:** 4-5 m
 - **Minimum installation height:** 3 m
 - **Maximum installation height:** 6 m

Note: the height should be relatively consistent throughout the tunnel.

- Beacons should be spaced every 10-50 m, although we recommend a maximum of 40 m. Measure the distance between beacons with a laser meter or wheel meter.
 - Note: you can also use existing markers as guides (i.e. signs, station markers, lights with known location, etc...); however, the spacing should be consistent throughout the tunnel.
- Keep at least 25 cm (2 wavelengths) between the beacon and any metal objects, such as power lines, antenna lines, etc. Placing beacons too close to metal objects can interfere with the beacon's signal, so make sure the beacon is always visible. If there's a metal sign that may block the beacon's signal:
 - If possible, move the beacon either to the left or right (maximum of 2 m), provided it remains completely visible to all lanes at a 40 m distance.
 - If there is no other option and the beacon must be obscured: Leave the side that faces oncoming traffic unblocked.
 - If, for example, you move a beacon 2m back: The marker should be at the original position so the beacon will be 38m from the previous beacon and 42m from the next beacon. Position markers should always remain consistently spaced.

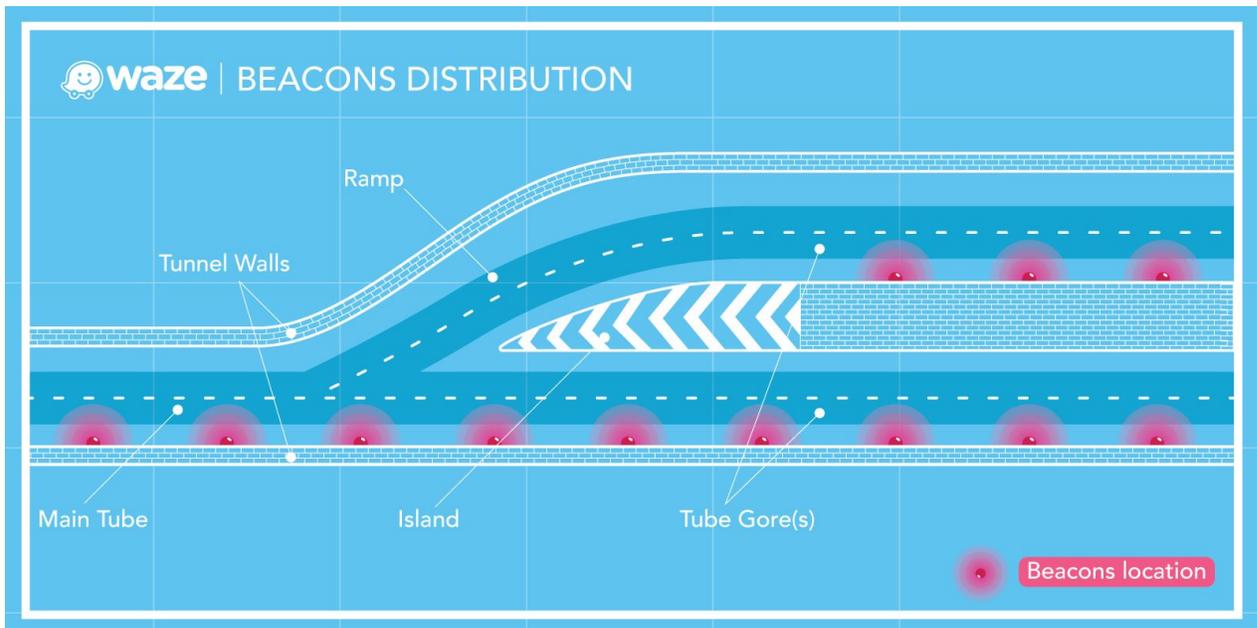
* To visualize the beacon's signal: Think of a flashlight that needs to be visible to cars driving through the tunnel. If a sign blocks the light from the cars vision, move the flashlight to the left or right - the same is true for the beacon.

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Complex Tunnels (Tunnels with on/off ramps)

- Each tunnel tube needs its own set of beacons. For merging and forking tubes, the main tube should always have the beacons continuing constantly; the joining/merging tube should have a separate set of beacons. Joint areas should not have duplicate sets of beacons, see illustration:



- In the case of most tubes, ramps will lead in/out of the tube from a specific side. To prevent gaps, install the beacons in the main tube on the side that has the least amount of ramps coming in/going out (i.e. along the wall with the least merges/forks/splits).
- Beacons on a ramp should be placed in a way that their backs are to the main tube as illustrated, unless doing so will cause the beacons to be installed on a wall that opens for a ramp.
- It's okay to switch the installation side in single lane ramps; in multi-lane ramps/main tubes, please try to avoid this as it will create "fuzzy" areas with limited coverage.

Installation instructions

- The beacons come pre-configured and labeled, however, we recommend marking the number in larger font on both sides of the beacon as well.
- **Important:** Make sure to install the beacons in numerical order, starting with the lowest number first (i.e. first install beacon #50, then #51, then #52, etc.). If you don't install the beacons in numerical order, there could be significant delays in the deployment.

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Step-by-step installation instructions:

Tiles and glass surfaces:

Required Materials:

1. [70% Isopropyl Alcohol \(IPA\)](#)
2. [Clean, White \(non-dyed\) cloth](#)
3. [3M Primer 94 \(specifications page\)](#)

Instructions:

1. Clean the wall using a solvent (**IPA 70%**) to remove soot and other dust, particles, etc. Use a **clean white** cloth.
2. Apply **3M Primer 94** and immediately wipe with a dry, white cloth.
3. Remove the beacon's tape adhesive liner.
4. Install the beacon where you applied the primer. (iBeek+ model: ensure so that the logo is facing oncoming traffic).
Make sure that the beacon appears leveled.
5. Push the beacon firmly against the wall for 6 seconds.

Concrete:

Required Materials:

1. [70% Isopropyl Alcohol \(IPA\)](#)
2. [Clean, White \(non-dyed\) cloth](#)
3. [3M Clean and Strip Disc CR-DA \(black disc\) 4.5 inch \(specifications page\)](#) or Metal Brush
4. [3M 80 Spray Adhesive \(specifications page\)](#)
5. (Optional) - [3M DP600](#) for damaged concrete ([specification page](#))

Instructions:

1. Clean the wall using **3M Clean and Strip Disc** (or a **metal brush**) and solvent (**IPA 70%**) with **clean white cloth** to remove soot and other dust, particles, etc.
2. Apply **3M 80 Spray Adhesive** and wait 1 minute for the spray to dry.
Note: For concrete in bad condition: Please apply [Concrete Repair DP600](#) first to damaged areas.
3. Remove the beacon's tape adhesive liner.
4. Install the beacon where you applied the spray (iBeek+ model: ensure so that the logo is facing oncoming traffic). Make sure that the beacon appears leveled.
5. Push the beacon firmly against the wall for 6 seconds.

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Metal surfaces

Painted Metal:

Required Materials:

1. [70% Isopropyl Alcohol \(IPA\)](#)
2. [Clean, White \(non-dyed\) cloth](#)
3. [3M Scotch 7447 \(specifications page\)](#)
4. [3M Primer 111 \(specifications page\)](#)

Instructions:

1. Carefully rub the surface using **3M 7447** pad.
2. Apply **Primer 111** to clean/prepare the surface, rub residue away (not just back and forth) while applying the primer.
3. Remove the beacon's tape adhesive liner.
4. Install the beacon where you applied the primer. Make sure that the beacon appears leveled.
5. Push the beacon firmly against the wall for 6 seconds.

Corroded Metal:

Required Materials:

1. [70% Isopropyl Alcohol \(IPA\)](#)
2. [Clean, White \(non-dyed\) cloth](#)
3. [3M Clean and Strip Disc CR-DA \(black disc\) 4.5 inch \(specifications page\)](#)
4. [3M Zinc Spray 16-501 \(specifications page\)](#)

Instructions:

1. Use **Clean and Strip Disc** to completely remove the Corrosion until you reach bare metal.
2. Clean the surface with a **dry white cloth** to remove particles.
3. Wipe the surface with **IPA** using a **white cloth**.
4. Apply **3M Zinc Spray 16-501**.
5. Remove the beacon's tape adhesive liner.
6. Install the beacon where you applied the spray (iBeek+ model: ensure so that the logo is facing oncoming traffic). Make sure that the beacon appears leveled.
7. Push the beacon firmly against the wall for 6 seconds.

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Low Temperature Warning

We don't recommend installing beacons at temperatures below 12°C (53°F); if you choose to install beacons at such temperatures (or lower), you may need to heat the surface and/or use MEK / Acetone. If you're using MEK / Acetone, please make sure to follow health and safety guidelines regarding the use of gloves, goggles, activated carbon filters, etc. Acetone is more effective than IPA at removing moisture at low temperatures but requires safety precautions.

Safety

The primer and spray are [extremely flammable](#). Make sure to have a fire fighting agent suitable for flammable liquids such as dry chemical or carbon dioxide nearby. During application, we recommend using a [respirator](#) (at least a P2) and [safety goggles](#).

Additionally, according to 3M, the primer and spray are much less flammable (similar to dry contact glue) once dried. Please consult your local 3M representative for more information.

Please make sure to read the instructions and safety manuals for all required equipment.

These guidelines outline the Waze beacon installation best practices according to our experience from experiments and trials. The mechanical responsibility lays upon the installer/tunnel operator and should be done according to the specifications documents of the adhesive, primer and spray:

1. **Adhesive:**

<http://multimedia.3m.com/mws/media/660190/vhbtm-tape-surface-preparation-technical-bulletin.pdf>

2. **Primer:**

<http://multimedia.3m.com/mws/media/659520/3mtm-tape-primer-94.pdf>

3. **Spray:**

<http://multimedia.3m.com/mws/media/7960780/rubber-and-vinyl-80-spray-adhesive.pdf>

Please consult with your engineers to make sure that these instructions are mechanically correct for your tunnel/tunnel materials/etc. Google will bear no responsibility for any mechanical failure involving the beacons.

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