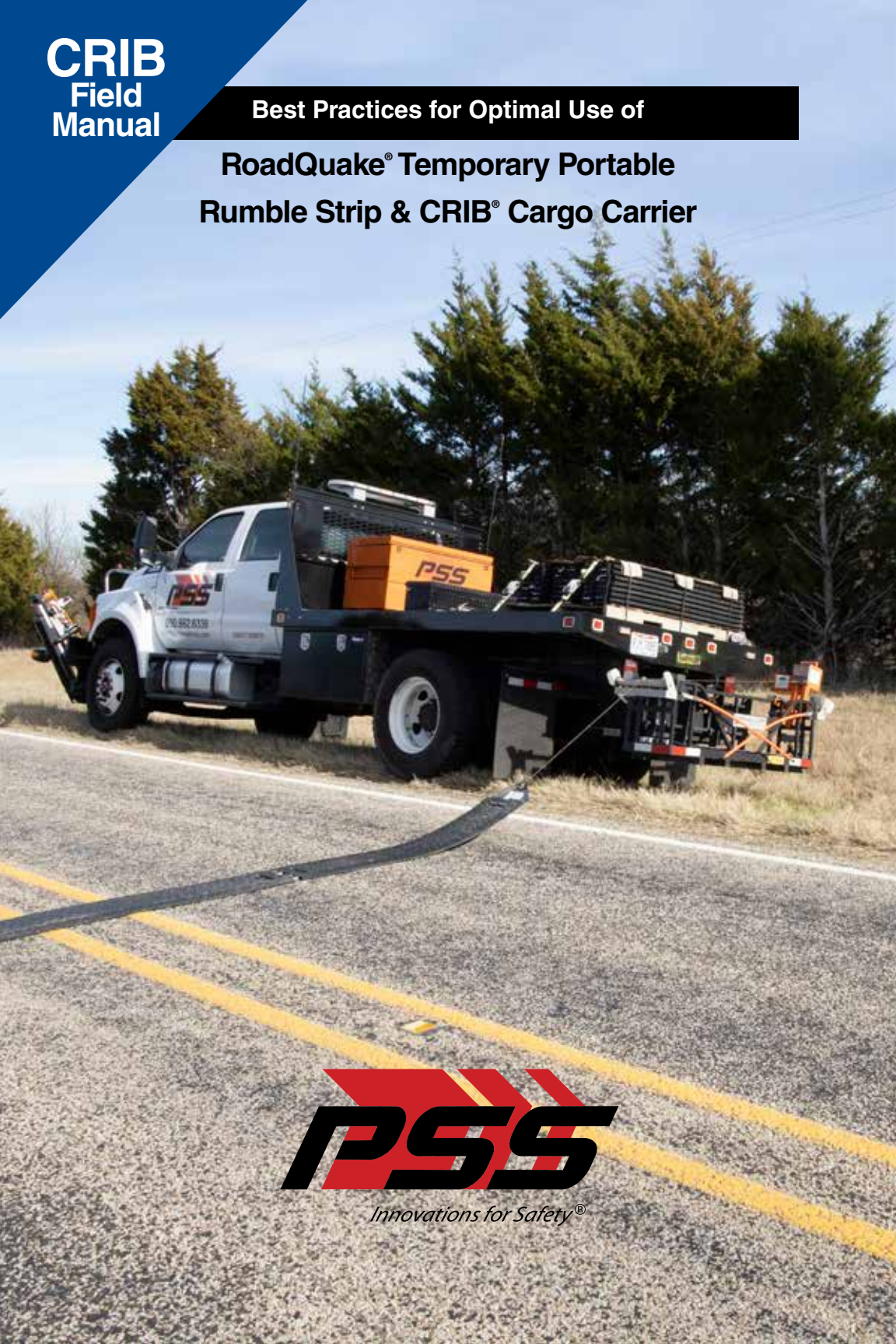
CRIB Field Manual

Best Practices for Optimal Use of

RoadQuake® Temporary Portable Rumble Strip & CRIB® Cargo Carrier



PSS

Innovations for Safety®

2

Contents

**RoadQuake® Temporary Portable Rumble Strip*

CRIB Field Manual:

PSS has made product upgrades to the RoadQuake® CRIB® cargo carrier including the newly integrated literature canister. This canister allows for easier access to CRIB literature and the RoadQuake® Nylon Pin Replacement Kits in the work zone. This CRIB Field Manual is an abridged version of the PSS RoadQuake Best Practices guide, which includes more comprehensive details on the full RoadQuake system of products.

This guide has been designed as a more concise reference tool for on-site guidance on CRIB usage and RoadQuake deployment and retrieval. For full details on RoadQuake uses, including proper care, product retirement, RAPTOR, and proposed specifications, please refer to our full Best Practices Guide for RoadQuake.

Preface to the Second Edition:

The overwhelming positive response to our “RoadQuake® Temporary Portable Rumble Strip: Best Practices for Optimal Use” guidebook prompts a Second Edition. That we have acquired more knowledge and experience with RoadQuake Temporary Portable Rumble Strip (RQ TPRS) is really a credit to you, the user.

In this edition: The “Protection of Workers” section, which begins on Page 15.

Other new features include:

- New RQ TPRS Product Improvement
- State DOT Traffic Control Plans
- Examples of road surface conditions
- New typical application drawings
- RQ TPRS and Portable Positive Protection
- Deploying RQ TPRS right side up

We trust our Second Edition will serve you as well as our First Edition. As always, we welcome your comments and questions.

RoadQuake TPRS, RAPTOR® Rumble Strip Handling Machine, CRIB® Cargo Carrier, and Retrieval System are proudly made in the USA.

PSS Innovations for Safety® – MADE IN – USA

Introduction to Best Practices for Optimal Use:

RoadQuake® 2F Temporary Portable Rumble Strip:

Designed to reduce accidents and save lives, RoadQuake 2F TPRS alerts distracted drivers to changing road conditions, like work zones and check points.

Features:

- Meets Section 6F.87 of the MUTCD, 2009 Edition.
- Generates similar levels of sound and vibration as milled strips.
- For posted speed limits up to 80 mph and temperatures from 0° to 180° F.
- 13" W x 3/4" H x 132" L, when unfolded. Covers an entire lane.
- Folds to a compact 66" length. Weighs 105 lbs (+ or -).
- Ergonomic handles make installation and storage easy. Non-slip textured surface helps to keep RoadQuake 2F TPRS in place.
- Bevels on both sides enhance motorcycle safety.

New Product Improvement:

We replaced metal chain link hinges with Breakaway Pin Connections. The metal chain link hinges allowed RoadQuake TPRS to fold. However, in extreme situations, the metal chain link hinges had the potential to tear through the polymer tabs at the end of a RoadQuake 2F half.

To better protect the strip itself, we developed the Breakaway Pin Connection. The pin connection consists of the existing RoadQuake 2F bracket, custom steel retaining clip, and impact-modified nylon pins. The Breakaway Pin Connection is designed to separate only under significant stress. The connections should not tear the strip itself, like metal chain link hinges may have done in extreme situations.

We call this a “clean separation.” As the tabs are not damaged during a “clean separation,” users can simply replace the breakaway pins, and return the strip to service.

Our Breakaway Pin Connection design improves RQ TPRS, as the pins can extend the life of a strip.

Contact your PSS Roadway Safety Consultant for information about ordering Breakaway Pin Connections.

4

Engineering Judgment:

Engineering judgment, as defined in MUTCD, 2009 Edition, Section 1A.13, is “the evaluation of available pertinent information, and the application of appropriate principles, provisions, and practices as contained in this Manual and other sources, for the purpose of deciding upon the applicability, design, operation, or installation of a traffic control device.”

MUTCD further states: “Engineering judgment shall be exercised by an engineer, or by an individual working under the supervision of an engineer, through the application of procedures and criteria established by the engineer. Documentation of engineering judgment is not required.”

PSS recommends that engineering judgment prevail in any decision to use RQ TPRS.

I.) Prior to Deployment:

A.) Examine the road surface at the deployment site:

Determine whether RQ TPRS will perform effectively at the site. RQ TPRS must maintain contact with the road surface. Use RQ TPRS on asphalt and concrete surfaces that are free of stone, gravel and debris.

Do not deploy RQ TPRS on these surfaces:

- Surfaces with fresh seal coat
- Unpaved surfaces (gravel roads)
- Soft pavement (fresh asphalt)

Deploy RQ TPRS with discretion on these surfaces:

- Heavily rutted roads
- Oil-bleeding asphalt
- Bridge decks
- Scarified Roads

See the next two pages for examples.

I.) Prior to Deployment, continued:

1.) Do not use RQ TPRS on these road surfaces:

These conditions could cause excessive movement or embedment of RQ TPRS. Further, these surfaces could cause irreparable damage to RQ TPRS.

Surfaces with Fresh Seal Coat:

Seal coat is a coating that protects and extends the life of asphalt pavement. It requires 24-48 hours to cure before traffic can resume.

Do not deploy RQ TPRS on fresh seal coat. Do not use RQ TPRS until vehicles are allowed back on the road surface.

Unpaved Surfaces (Gravel Roads):

A gravel road is an unpaved road surface to which gravel is applied.

Do not use RQ TPRS on gravel roads. Gravel can act as rollers underneath the strips, causing significant movement, reducing their effectiveness. Gravel can also embed in the bottom of strips, also reducing effectiveness.

Soft Pavement (Fresh Asphalt):

Fresh asphalt, like seal coat, requires 24-48 hours to cure. Do not deploy RQ TPRS on any soft pavement, like fresh or soft asphalt. Wait until traffic is allowed to resume.

The picture on the left shows the result of RQ TPRS deployed, and the road reopened to traffic, before the asphalt cured.

I.) Prior to Deployment, continued:

2.) Use RQ TPRS with discretion on these road surfaces:

Users can deploy RQ TPRS on these types of surfaces, but must monitor the strips more frequently, as these surfaces may cause excessive movement.

Heavily Rutted Roads:

A rut is a groove or depression in the road surface. Ruts are caused by wear or deformation of the substrate material.

Oil-Bleeding Asphalt:

Bleeding occurs when the asphalt binder fills voids in the aggregate, usually during hot weather.

Bridge Decks:

Most bridges vibrate under traffic. A bridge structure is flexible, and, as designed, vibrates in response to the moving traffic.

Scarified Road:

A Scarified road is one that has had its pavement surface removed in preparation for resurfacing.

I.) Prior to Deployment, continued:

B.) Examine other conditions:

- Do not use RQ TPRS on horizontal curves. The force and angle of the vehicle traveling in the curve could force strips to move to the outside of the curve.
- Identify traffic speeds in advance of and at the work site. RQ TPRS should perform effectively in posted speed limits up to 80 MPH.

- RQ TPRS will perform on roads with slopes, but the strips will move more when downhill than when on relatively flat roads. And, the steeper the slope, the more the strips will move. Engineering judgment should prevail in this application.
- RQ TPRS will perform in temperatures from 0° to 180° F. Excessive snow and rain may limit use of RQ TPRS.

C.) Train the On-Site Workforce:

RQ TPRS training should include:

- Purpose of RQ TPRS: features and benefits.
- How RQ TPRS serves as an audible warning device for workers.
- Why motorcycles can safely traverse RQ TPRS.
- How to safely deploy and remove RQ TPRS, per our “Best Practices Guidebook.”
- How RQ TPRS handling equipment reduces workers’ exposure to live traffic, and reduces possibility of soft tissue injury.

PSS offers both live training and online training. Please contact your PSS Roadway Safety Consultant for more information.

II.) Transport of RQ TPRS:

Several options are of course available for the transport of RQ TPRS to and from the work site. PSS recommends that users plan in advance, as TPRS devices can occupy significant space in a service vehicle.

PSS has designed a complete line of rumble strip handling equipment.

These products:

- Alleviate space limitations.
- Reduce or eliminate superficial injuries to workers.
- Reduce or eliminate workers exposure to live traffic.

Please contact your PSS Roadway Safety Consultant for more information.

III.) Array Configuration and Placement:

A.) Number of Strips in an Array:

PSS developed the first RQ TPRS in 2006, and introduced the first production version in early 2009.

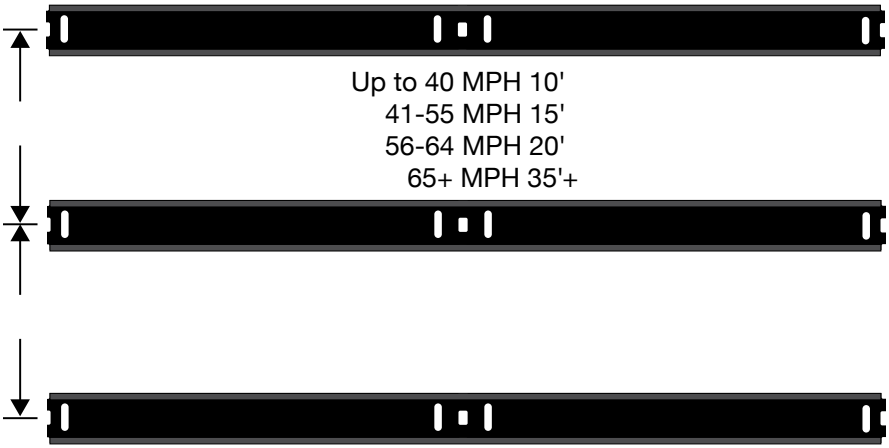
After years of observation in active work zones, with several studies as support, PSS has determined that three rumble strips per array are sufficient to alert drivers to changing road conditions. Three strips, properly spaced, alert drivers with sufficient sound and vibration so that they refocus on their driving.

As always, follow state DOT Traffic Control (TC) Plans as to the number of strips per array. Absent a TC plan, PSS recommends three rumble strips per array.

B.) Spacing of Strips in an Array:

In the absence of a TC plan, PSS recommends spacing between strips, based on posted speed limits at the deployment location, as shown below:

Spacing Between Strips
All Spacing on Center



For posted speeds in excess of 65 MPH: PSS recommends that users increase spacing as posted speed limits increase. Increasing space between rumble strips will improve effectiveness.

III.) Array Configuration and Placement, continued:

C.) Number of Arrays in a Work Zone:

With the experience stated above, **PSS recommends the placement of two each RQ TPRS arrays per travel direction** in advance of changes in road conditions. Two arrays should sufficiently alert drivers, especially distracted drivers, to those changing road conditions.

Traveling over the 1st array, the car produces sound and vibration designed to alert the drivers and make them aware of their surroundings and changing road conditions. Independent research shows that drivers passing over RQ TPRS slow down an average of three to five MPH, as they refocus their attention on driving. And, they may even see the advanced warning signs nearby.

It could be argued that the 2nd array is even more important than the 1st:

The 2nd array warns drivers that:

- The 1st array is not debris on the road.
- The 1st array has been deployed intentionally.
- Drivers will soon approach the change in road condition.
- They must soon take action.
- They should not accelerate as they approach the changing road condition.

The 2nd array also warns on-site workers, especially flaggers, that traffic is nearby and approaching.

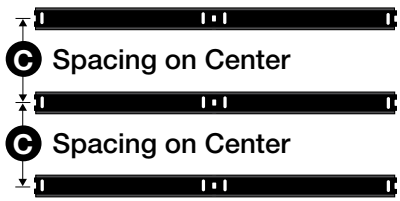
As always, follow state DOT TC Plans for the number of arrays in a work zone. But again, absent a TC plan, **PSS recommends two arrays per travel direction.**

Recommended Placement of RQ TPRS Arrays

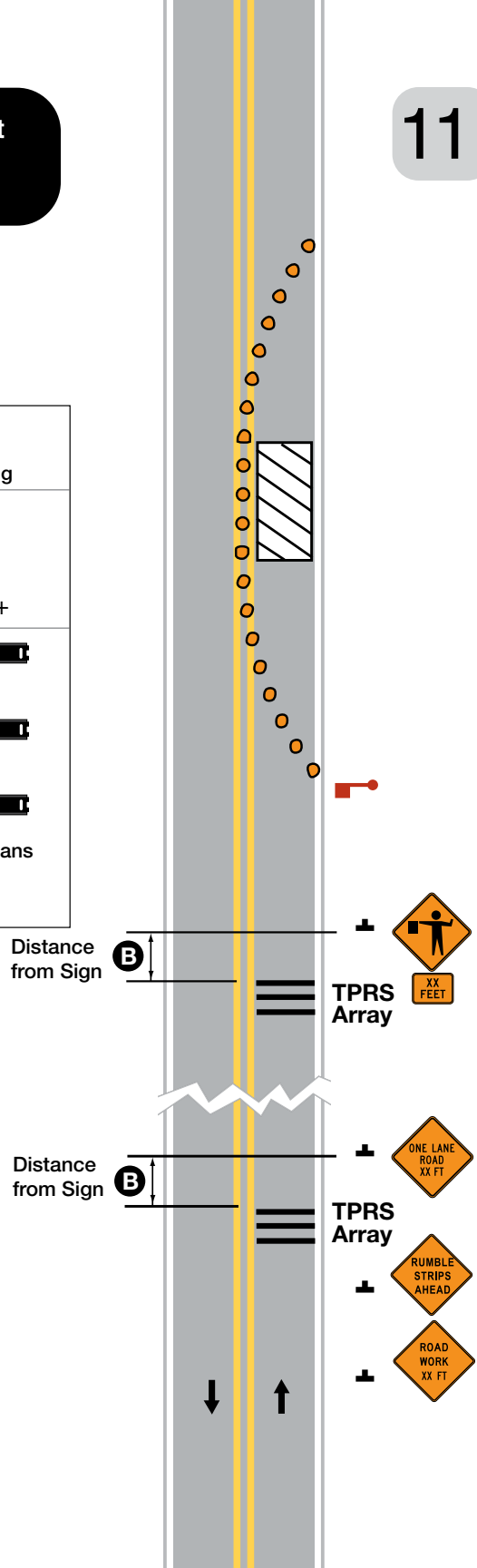
Lane Closure on a Two-Lane Roadway, Using Flaggers

Showing one direction only

Speed	B Distance	C Spacing
To 40 MPH	120'	10'
41-55 MPH	160'	15'
56+ MPH	200'	20'
65+ MPH	240'	35'+



Follow state DOT Traffic Control Plans for sign and lane taper spacing.



Follow state DOT TC plans where available.

From MUTCD, 2009 Edition
Typical Application 10

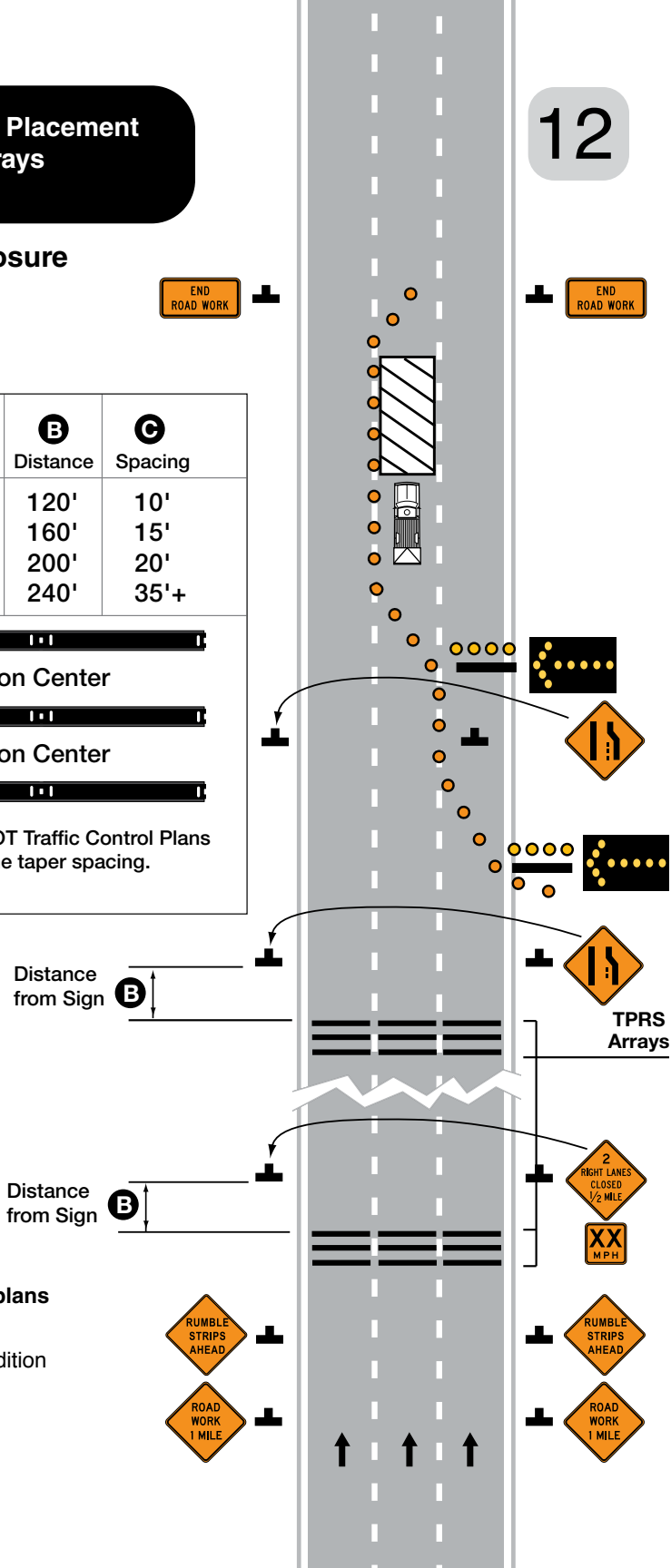
Drawing not to scale.

Recommended Placement of RQ TPRS Arrays

Double Lane Closure on a Three-Lane Freeway

Speed	B Distance	C Spacing
To 40 MPH	120'	10'
41-55 MPH	160'	15'
56+ MPH	200'	20'
65+ MPH	240'	35'+

Follow state DOT Traffic Control Plans for sign and lane taper spacing.



Follow state DOT TC plans where available.

From MUTCD, 2009 Edition
Typical Application 37

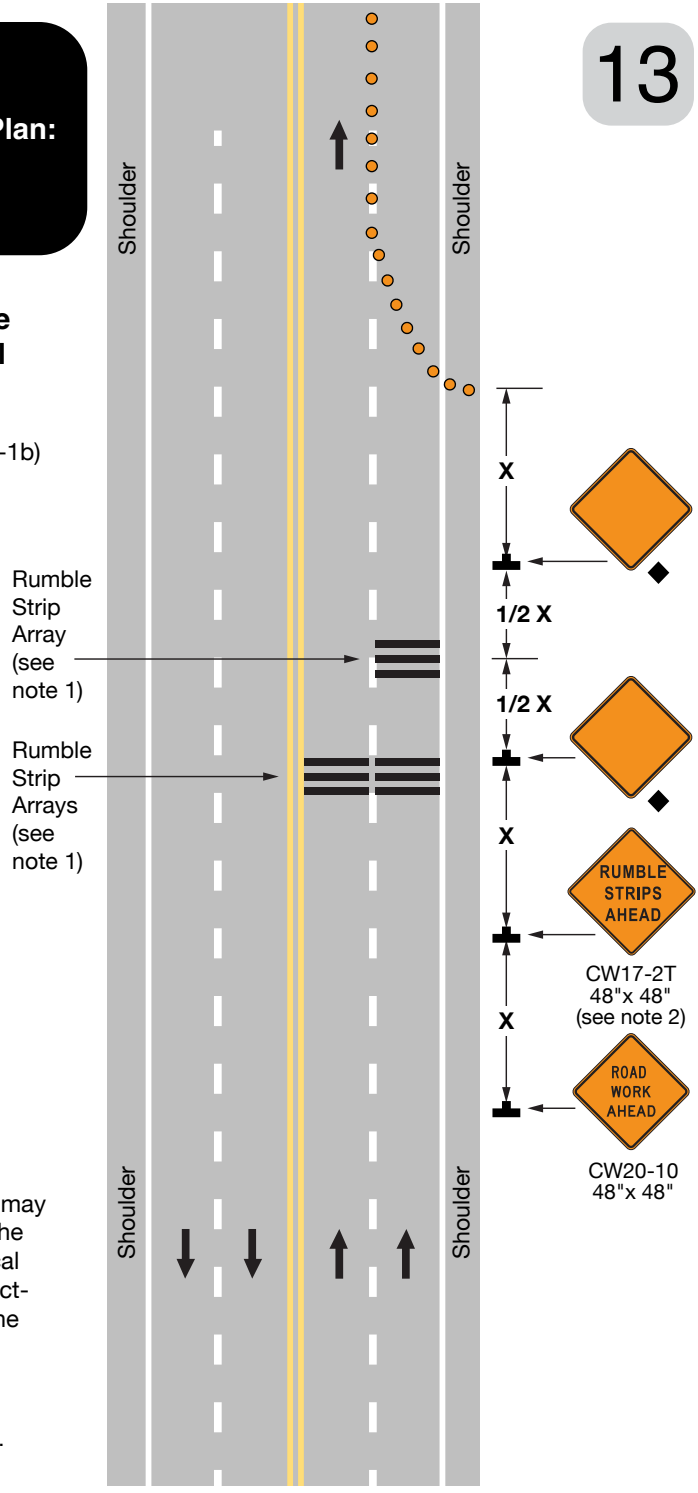
Drawing not to scale.

Example of a State DOT Traffic Control Plan:

Texas DOT

Rumble Strips for Lane Closure on Conventional Roadway

From TxDOT WZ(RS-1b)



◆ Signs are for illustrative purposes only. Signs required may vary depending on the TCP, TMUTCD Typical Application, or project-specific details for the project.

Drawing not to scale.

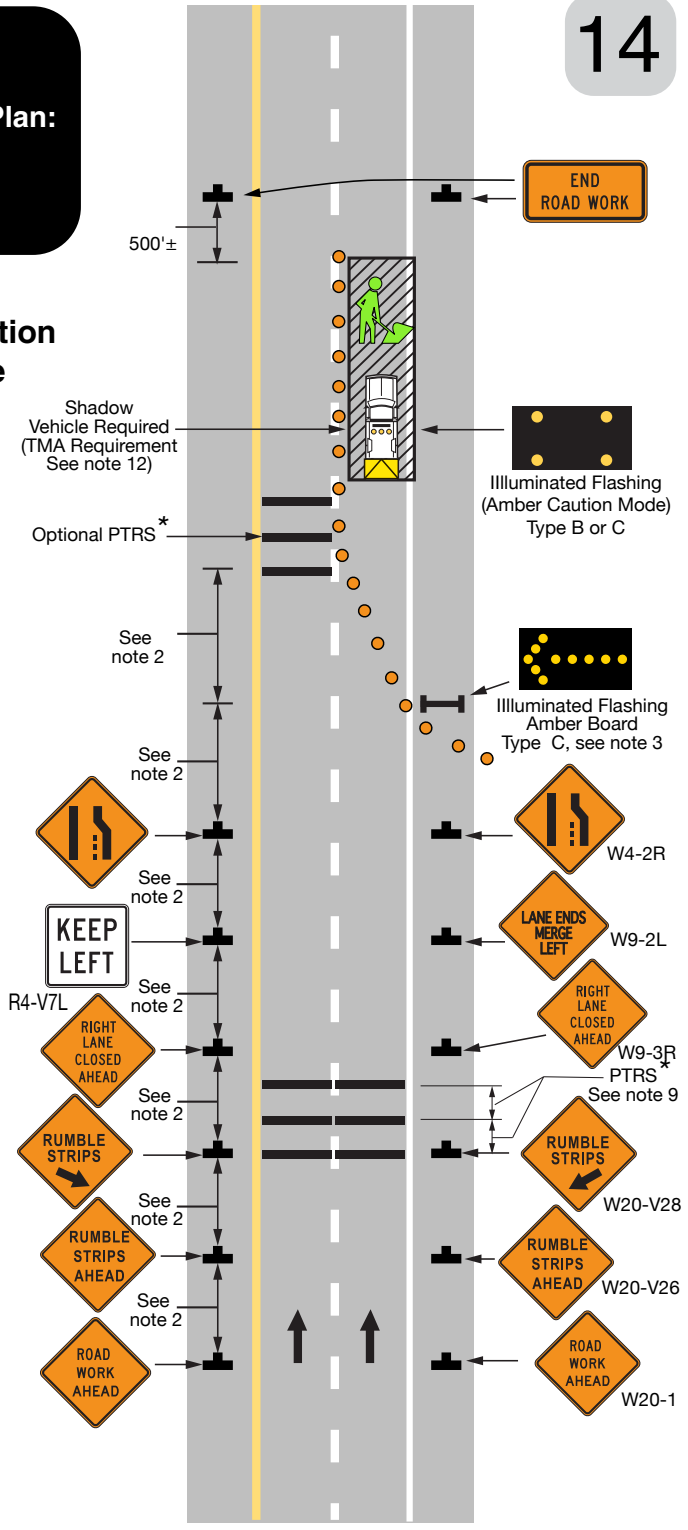
Notes not included.

Example of a State DOT Traffic Control Plan:

Virginia DOT

Typical Installation on a Multi-Lane Roadway

From Virginia DOT Memorandum IIM-TE-386.1 Page 10



*PTRS = TPRS

Drawing not to scale.

Notes not included.

IV.) Protection of Workers:

A.) General Notes:

- Where available, follow state DOT specifications and TC plans for the deployment and use of RQ TPRS arrays.
- Always deploy temporary traffic control (TTC) devices, specified by state DOT traffic plans, to protect workers during deployment of RQ TPRS arrays.
- PSS recommends, where appropriate, that workers use the “Rolling Stop” method to clear travel lanes for deployment of RQ TPRS arrays.
- RAPTOR® Rumble Strip Handling Machine transports, deploys, realigns and retrieves RQ TPRS in work zones, keeping workers off the road, out of live traffic.

- PSS also recommends the use of police vehicles, and vehicles equipped with Truck or Trailer-Mounted Attenuators (TMA), to protect workers during deployment. Placed in the travel lanes upstream of the deployment location, both police and TMA vehicles can protect workers in the travel lanes better than service vehicles.

B.) Lifting Techniques:

PSS recommends RQ users follow lifting guidelines like those from OSHA:

Use of proper lifting techniques when performing manual lifts will minimize the risk to the back, but a heavy load still can cause injury even with perfect technique:

- Maintain neutral spine alignment whenever possible. Usually, bending at the knees, not the waist, helps maintain proper spine alignment.
- Keep the load close to the body. For large bulky loads, it may be better to bend at the waist instead of the knees because this will keep the load closer to the body. Do not reach to access a load.
- Minimize bending of the body by keeping the load between shoulder and thigh height when lifting. Keep heavier loads off the floor.
- Lift heavier or bulky loads with a buddy.
- Strengthen back and abdomen muscles that support your spine.

– “OSHA Ergonomics-related eTools, Electrical Contractors”,
www.osha.gov/dts/osta/oshasoft/index.html

IV.) Protection of Workers, continued:

C.) Lifting RQ 2F TPRS:

Step 1: Do not pick up the non-hinged side of RoadQuake® 2F TPRS by hand, as pinching might occur. PSS recommends the use of RoadQuake® T-Handle™, as shown above, to pick the strip up from the non-hinged side.

Step 2: Once in place, remove the T-Handle from the non-hinged side.

Step 3: Then, simply unfold the rumble strip.

Step 4: Place in position.

Further:

- Workers can use RoadQuake T-Handle on either side of the strip.
- Use of hands is acceptable for hinged side only. Do not pick up non-hinged side by hand.

Warning:

Do not put your hand through both handles of the non-hinged side of a folded strip when transporting RoadQuake 2F TPRS.

Doing so may cause severe pinching or a more serious injury.

If carrying by hand, use the RoadQuake T-Handle on the non-hinged side to transport RoadQuake 2F TPRS.

V.) Deployment of RQ TPRS Arrays:

A.) Advance Warning Signs:

- Where available, follow state DOT specifications and TC plans for the deployment and use of RQ TPRS arrays.
- PSS recommends the deployment and use of warning signs with RQ TPRS arrays. The signs should read, “Rumble Strips Ahead,” or some variation of. The signs alert drivers who are monitoring warning signs that the arrays are supposed to be on the road, not hazards to be avoided.
- Follow state DOT TC plans to determine proper signage placement.
- Where there is no TC plan, or where the plan does not specify “Rumble Strips Ahead” signs, please follow recommendations shown in drawings, “PSS Recommended Placement of RQ TPRS Arrays,” on Pages 11-12.

B.) Site Preparation:

- Determine the proper location from which to deploy RQ TPRS. The safety of the worker is paramount. PSS recommends the use of shoulder or berm whenever available.
- Prior to deployment, sweep area clear of gravel and other debris, if traffic allows. Gravel, stone or other debris may prevent the strips from making contact with the road surface, causing excessive movement of the strips.
- Prior to deployment, determine the proper spacing between strips, as specified in the state DOT TC plan. If a plan is not available, see Page 11-15, for PSS recommendations.
- To reduce deployment time, mark the pavement with a line, perpendicular to traffic, to identify the placement of each strip. PSS recommends temporary paint marking.

C.) Preparation of Strips:

RoadQuake 2F TPRS is a one-piece device, and requires no assembly.

RoadQuake 2F folds for easier transport. Workers can either unfold RoadQuake 2F and then carry strips to the deployment location, or carry strips folded to the location, and then unfold them in the travel lane.

RAPTOR Rumble Strip Handling Machine transports, deploys, realigns and retrieves RQ TPRS in work zones, keeping workers off the road, out of live traffic.

V.) Deployment of RQ TPRS Arrays, continued:

D.) Deployment of Strips with RoadQuake Handling Equipment:

With RoadQuake Handling Equipment:

- Workers can deploy and move TPRS arrays faster.
- Workers are less exposed to traffic.
- Equipment reduces possible injury caused by lifting and carrying TPRS.

E.) Manual Deployment of TPRS:

With “Rolling Stop” in operation, traffic control in place, advanced warning signs installed, and the service vehicle with RQ TPRS parked adjacent to the deployment location:

1.) Remove RQ TPRS from the service vehicle.

2.) Walk strips to the marked lines on the pavement.

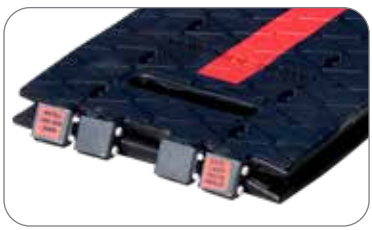
3.) Lay strips in place.

4.) Follow this illustration to deploy TPRS with the top side facing up.

Deploying RQ TPRS upside down can cause significant damage to vehicles, and injury to drivers, passengers and workers.

F.) Warning Visuals:

PSS now applies safety-yellow warning stickers to two brackets on every RQ TPRS. The sticker reads: INSTALL THIS SIDE DOWN in both English and Spanish. They are printed in safety-red to attract workers’ attention.

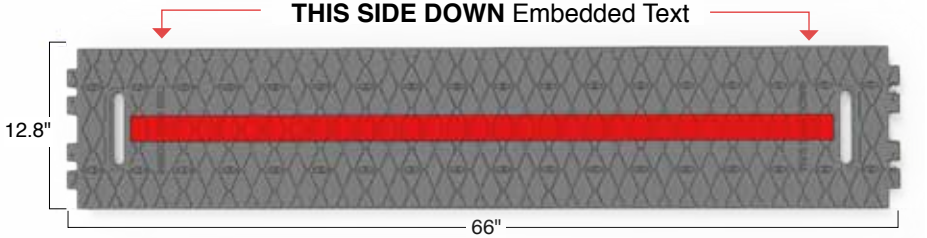


V.) Deployment of RQ TPRS Arrays, continued:

PSS will soon add a red stripe to the bottom of the entire length of RoadQuake 2F TPRS. The red stripe identifies the bottom of the strip. We will also embed text near the handles that reads: “THIS SIDE DOWN”. See graphic below for both visuals.

The text and red stripe on the bottom of the strip send a clear, unmistakable message to workers: the red stripe and text side is the bottom side, which must face the roadway. Bottom side down.

If workers deploy strips correctly, top side up, they will not see any red stripes. If they deploy strips incorrectly, bottom side up, they will clearly see red stripes. They must immediately redeploy those strips, so that the top side is up, before traffic drives over them.



Embedded Text and Red Stripe on Bottom of RoadQuake 2F TPRS (1/2 Strip Shown)

The picture on right reveals multiple errors:

- RQ TPRS strips are deployed upside down, which could cause significant damage to vehicles.
- Strips are spaced incorrectly, reducing their effectiveness. See Page 9 for “Spacing of Strips in an Array.”
- Strips are painted over in both roadway paint colors. Drivers who approach the RQ TPRS array could mistake the strips for tire tread or planks of wood. Drivers might attempt to drive around the strips, which could cause crashes. See Page 20 for more information about “Driver Avoidance.”

Users must deploy RQ TPRS right-side up, and must space strips properly. Users should also remove the strips from the roadway before striping trucks begin their work.

VI.) Monitor Deployed RQ TPRS Arrays:

A.) Monitoring for Changes in Traffic Queue:

RQ TPRS arrays effectively alert drivers to changes in road conditions, like a lane closure, or slowing or stopped traffic. They lose effectiveness if the traffic queue builds upstream of their location.

Users should constantly monitor the length of queue. If the end of the queue approaches the RQ TPRS arrays, recalculate the new position for the arrays and redeploy them.

B.) Repositioning TPRS Arrays:

If a strip requires repositioning, due to movement, workers should follow the same procedures as with the original deployment.

If engineering judgment dictates that ADT is so high that there are no gaps in traffic for workers to reposition strips manually, thus making that task exceptionally hazardous, then TPRS arrays should be considered inappropriate for manual deployment in that situation.

However, with RAPTOR Rumble Strip Handling Machine, workers can reposition or realign RQ TPRS from the safety of their vehicle.

C.) Driver Avoidance:

PSS has received reports of drivers who have attempted to avoid driving over an array by driving around it. This action by the road user may be considered unsafe, but it usually indicates a cognizant action by a driver that is not distracted.

Also, a recent university study reported that driver avoidance was statistically insignificant in work zones that included RQ TPRS. (Contact your PSS Roadway Safety Consultant for more information.)

PSS recommends placing at least one each TTC device, like a plastic traffic drum or 42" channelizer, at each side of an array. Drivers will then know they are to proceed over the array.

Do not place vehicles or workers adjacent to RQ TPRS arrays.

VI.) Monitor Deployed RQ TPRS Arrays, continued:

D.) Types of Movement and Allowance Guidelines:

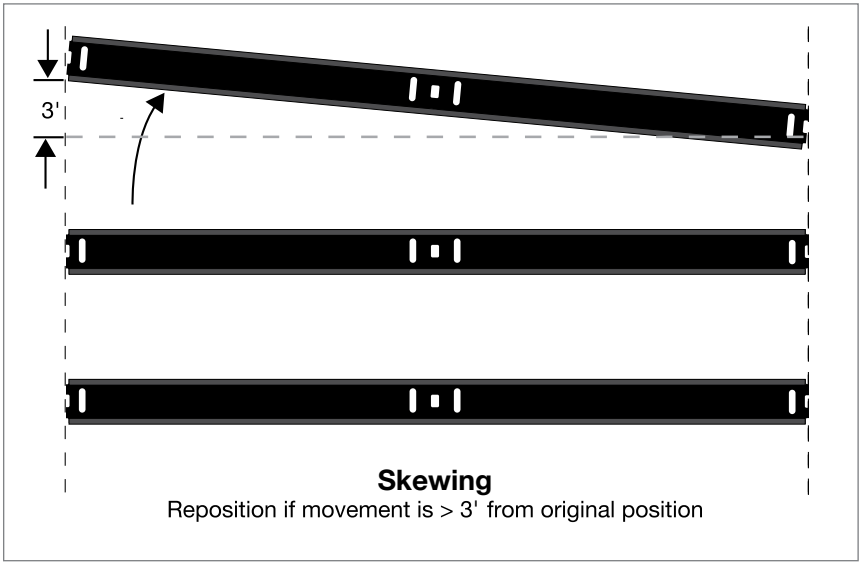
PSS has identified three types of movement:

1.) Skewing: TPRS may deviate from a straight line, either from the centerline of the road towards the shoulder, or vice versa.

2.) Lateral movement: TPRS may move side-to-side, from the shoulder of the road to the centerline, or vice versa.

3.) Movement Perpendicular to Travel: TPRS may move as an array in the direction of traffic, or in the opposite direction, from the original deployment position.

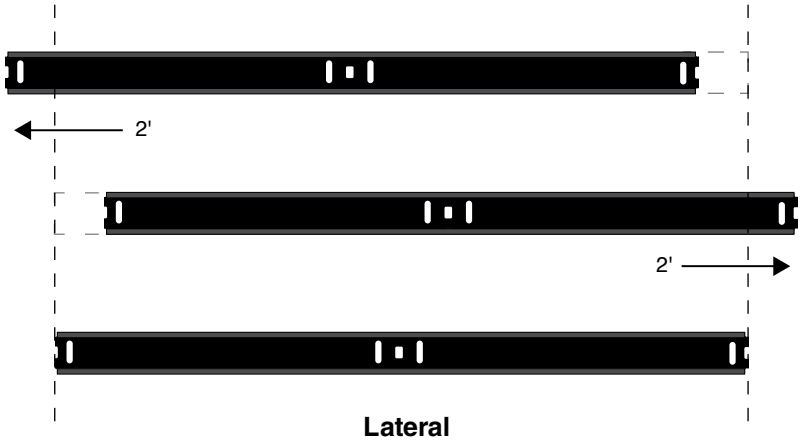
Refer to the following graphics for suggested allowances of each type of movement:



Skewing
Reposition if movement is > 3' from original position

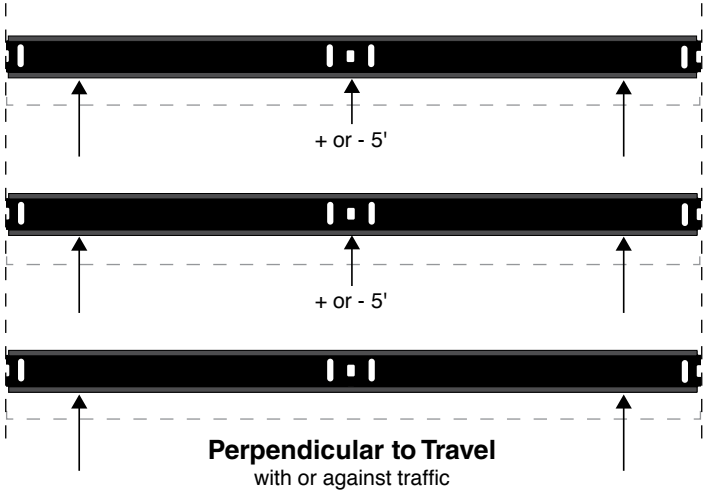
VI.) Monitor Deployed RQ TPRS Arrays, continued:

Refer to the following graphics for suggested allowances of each type of movement:



Lateral

Reposition if movement is > 2' from original position



Perpendicular to Travel

with or against traffic

Reposition if movement is + or - 5' from original position

VII.) Removal, Security, Cleaning:

A.) Removal and Security:

Workers should follow the same procedures for removing RQ TPRS arrays as when deploying them.

RQ TPRS is a temporary device, and subject to theft. RQ TPRS should not be left at the work site after workers leave. If users choose to leave them at the site, PSS recommends stacking the strips, and running a bicycle cable lock through the handles. Several strips locked together could weigh far more than practical to carry away.

Rather than leaving strips in an accessible area, PSS recommends that workers secure RQ TPRS in a locked vehicle or building, or in a yard behind locked security fencing. Workers may of course leave RQ TPRS in our CRIB® Cargo Carrier, or RoadQuake RAPTOR Rumble Strip Handling Machine, but the vehicle should be secured in a building or behind security fencing.

B.) Cleaning Instructions:

To remove gravel, stones, mud or other material, we recommend using a water-based cleaner and a stiff brush to scrub the strip clean. A good cleaning should only take minutes.

We do not recommend, and caution users to avoid, oil-based cleaners and solvents. Oil-based cleaners can degrade engineered polymer products, like RQ TPRS, and affect performance.

VIII.) RQ TPRS Inspection:

A.) Inspection and Service Life:

The life expectancy of RQ TPRS under normal use is three years. RQ TPRS nevertheless requires routine inspection and cleaning.

PSS recommends daily inspection of RQ TPRS retrieved from active work zones. Users should inspect for gravel, mud, stones or asphalt embedded in the bottom surface of RQ TPRS. If left as is, extraneous material could affect performance. See “Cleaning Instructions” above.

Users should also inspect each RQ TPRS to determine if it had been damaged when deployed, or if it has reached the end of its service life.

Follow us on:

Innovations for Safety®

We are a proud member of:

ATSSA ARTBA IBTTA IRF GLOBAL

PSS | 2444 Baldwin Road, Cleveland, OH 44104 | 800.662.6338 | PSS-Innovations.com | 7/20