



QUEST[®] DCM System

CRASH CUSHION

PRODUCT MANUAL

QUEST® DCM System

Table of Contents

System Overview	3
Crash Performance	3
Parts Identification	4
Inspect Shipping	4
Assembly	14
Installation	34
Required Tools	34
Site Preparation/Foundation	35
Installation Procedures	38
Optional DPA Anchorage	41
Bidirectional Traffic	44
Transition and Side Panel Types	44
MP-3® Polyester Anchoring System	45
Vertical Installations	45
Horizontal Installations	46
MP-3 Installation Cautions	47
Maintenance Checklist	48
Visual Drive-by Inspection	48
Walk-Up Inspection	48
Post-Impact Instructions	49
General Maintenance Information	49
Required Tools	49
Procedure	50
Parts Ordering Procedure	50
Limitations and Warnings	51

RETURN GOODS POLICY

Before returning any goods for credit please contact Valtir, LLC. Customer Service Department at 1 (214) 589-8140 or your local Valtir distributor for proper instructions.

The purpose of this manual is to provide assembly, installation and maintenance instructions for the QUEST DCM System. Please acquire the proper installation drawings from the manufacturer to use in conjunction with this manual prior to installing a QUEST DCM System.

Proper installation of the QUEST DCM System is essential to assure maximum performance. Take the time to review this manual including “Limitations and Warnings” on page 51 thoroughly before performing the necessary work. Do not attempt to install the QUEST DCM System without the proper plans and a thorough review of this installation manual.

If you need additional information, or have QUESTions about the QUEST DCM System, please call:

Valtir, LLC. Customer Service De-partment at 1 (214) 589-8140 or your local Valtir distributor.

When reading this manual, please note the following:

WARNING!

Indicates a situation that **will** cause physical and/or property damage.

Caution: Indicates a situation that **could** possibly cause physical and/or property damage.

Note: Indicates a matter of interest or clarification.

QUEST® DCM System

System Overview

The QUEST DCM System is a highly efficient redirective, bidirectional crash cushion designed to shield hazards 610 mm or less in width. The backup is designed to be placed against and nest around the hazard, resulting in a shorter overall installation length.

Crash Performance

The QUEST DCM System has successfully passed the European Standard EN 1317:2000 tests. The QUEST DCM System has also been tested and evaluated per the criteria set forth in *National Cooperative Highway Research Program (NCHRP) Report 350, 1993 for redirective, non-gating terminals and crash cushions. For a list of the tests, see the Limitations & Warnings section of this manual.

During head-on impacts, the QUEST DCM System telescopes rearward and energy is absorbed through momentum transfer, friction and deformation. When im-

pacted from the side, the QUEST DCM System restrains lateral movement by dynamic tension developed between end restraints and safely redirects the impacting vehicle.

*NCHRP Report 350 =

National Cooperative Highway Research Program Report 350

Copy may be obtained from:

Transportation Research Board

National Research Council

2101 Constitution Avenue, N.W.

Washington, D.C. 20418

It is also available at:

http://safety.fhwa.dot.gov/programs/roadside_hardware.htm

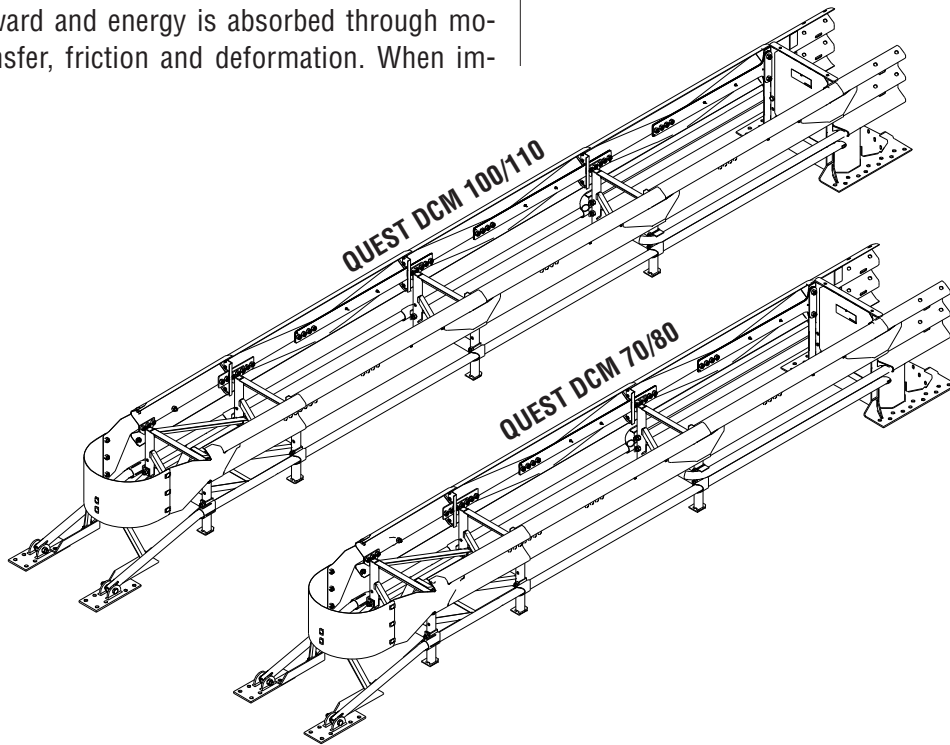


Figure 1
QUEST DCM System

QUEST DCM Model Numbers			
Name	Model No. Unassembled	Model No. Pre-Assembled	Performance Level (km/h)
QUEST DCM 100/110	TD110DCM610	TD110DCM610A	100/110
QUEST DCM 70/80	TD80DCM610	TD80DCM610A	70/80

QUEST® DCM System

Parts Identification

Inspect Shipping

Before assembling the QUEST DCM System, check the received parts against the **shipping list supplied with the system**. Make sure all parts have been received.

QUEST DCM 100/110

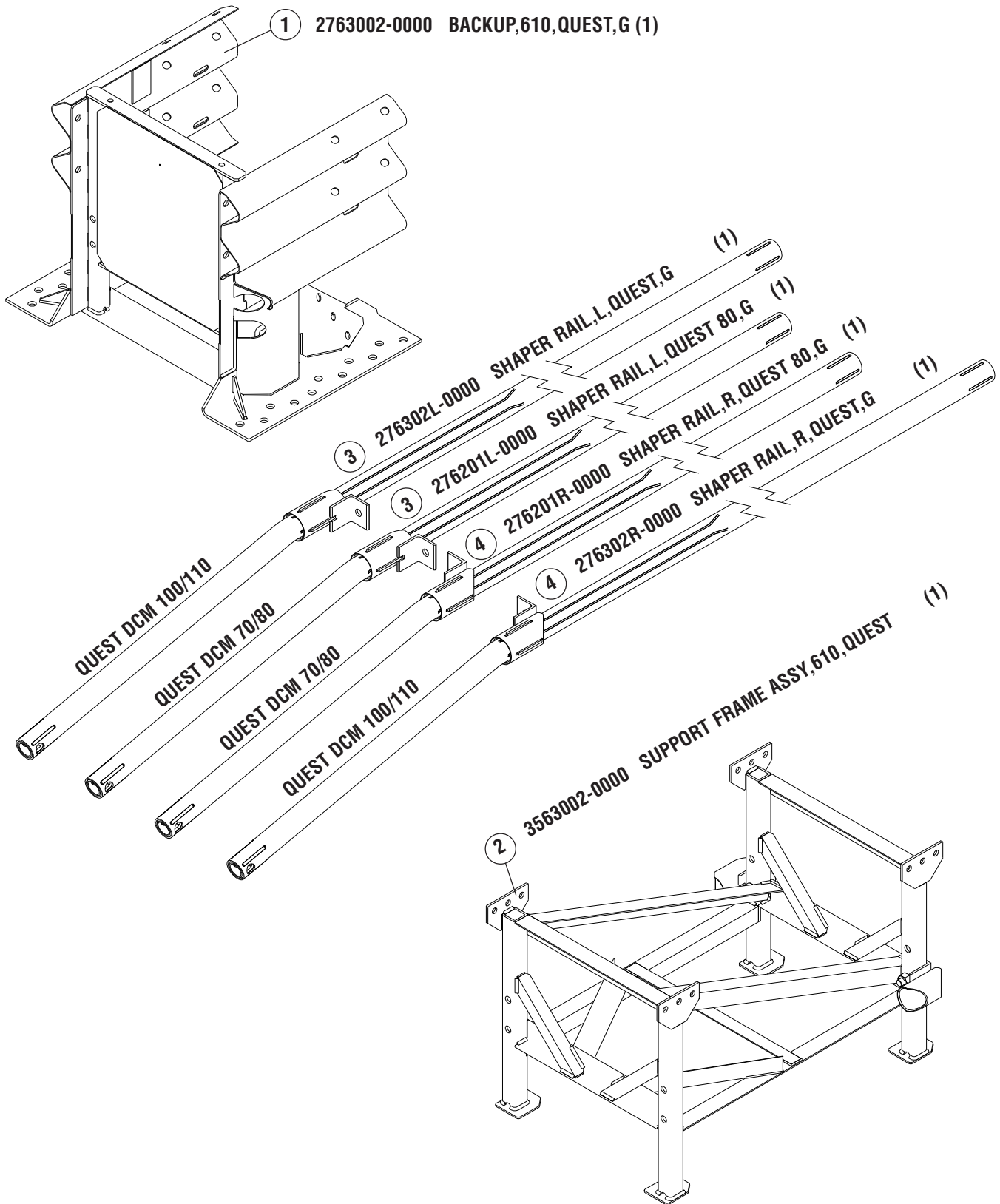
Parts List (TD110DCM610)			
Item	Stock No.	Description	Qty.
1	2763002-0000	BACKUP,610,QUEST,G	1
2	3563002-0000	SUPPORT FRAME ASSY,610,QUEST	1
3	276302L-0000	SHAPER RAIL,L,QUEST,G	1
4	276302R-0000	SHAPER RAIL,R,QUEST,G	1
5	2763012-0000	ANCHOR,FRONT,QUEST,G	2
6	3563001-0000	TRIGGER ASSY,QUEST	1
7	2763011-0000	TRIGGER STRAP,QUEST,G	2
8	2763014-0000	NOSE TRANSITION,L,QUEST,G,PT	1
9	2763013-0000	NOSE TRANSITION,R,QUEST,G,PT	1
10	2763015-0000	NOSE,QUEST,G,PT	1
11	3563003-0000	DIAPHRAGM ASSY,610,QUEST	2
12	2763024-0000	SHAPER,BACKUP,QUEST,G	2
13	2763023-0000	REAR RAIL,QUEST,G	2
14	2763020-0000	STRAP,PEEL,REAR,QUEST	2
15	2763021-0000	STRAP,PEEL,BAY 2,QUEST	2
16	2763022-0000	STRAP,PEEL,BAY 3,QUEST	2
17	2763006-0000	FLT ST 6X70X270,W/HOLES,G	2
18	2763017-0000	FLT ST 6X100X350,W/SLOTS,G	2
19	2763018-0000	PANEL,BAY 1,QUEST,G	2
20	2763010-0000	PANEL,BAYS,QUEST,G	6
21	2763019-0000	BRACE,PANEL,QUEST,G	6
22	2706049-0300	SCREW,PN,M3.5X0.6X40,PHIL,S	12
23	2708049-0000	WASHER,BAR,50X50X6,22 HOLE,G	2
24	2708047-0100	WASHER,FLAT,M10,P	48
25	2708050-0000	WASHER,FLAT,M16,G	6
26	2708051-1000	WASHER,BAR,50X30X6,ROUNDED,G	8
27	2708048-0300	WASHER,FLAT,M3.5,S	24
28	2704921-0000	NUT,HX,M10X1.5,8.8,G	24
29	2704923-0000	NUT,HX,M16X2,RAIL,G	72
30	2704925-0000	NUT,HX,M16X2,10.9,G	6
31	2704924-0000	NUT,HX,M20X2.5,10.9,G	10
32	2704922-0000	NUT,HX,M24X3,8.8,G	2
33	2704772-0300	NUT,HX,#6-32,S	24
34	2699061-0000	BOLT,HX,M10X1.5X25,8.8,G	24
35	2699062-0000	BOLT,RAIL,M16X2X35,G	54
36	2699056-0000	BOLT,RAIL,M16X2X50,G	18
37	2699054-0000	BOLT,HX,M16X2X50,8.8,G	6
38	2699059-0000	BOLT,HX,M20X2.5X100,8.8,G	2
39	2699055-0000	BOLT,HX,M20X2.5X90,8.8,G	4
40	2699057-0000	BOLT,HX,M20X2.5X50,8.8,G	4
41	2699058-0000	BOLT,HX,M24X3X90,8.8,G	2
42	2699060-0000	BOLT,HX,M24X3X120,10.9,G	2

QUEST® DCM System

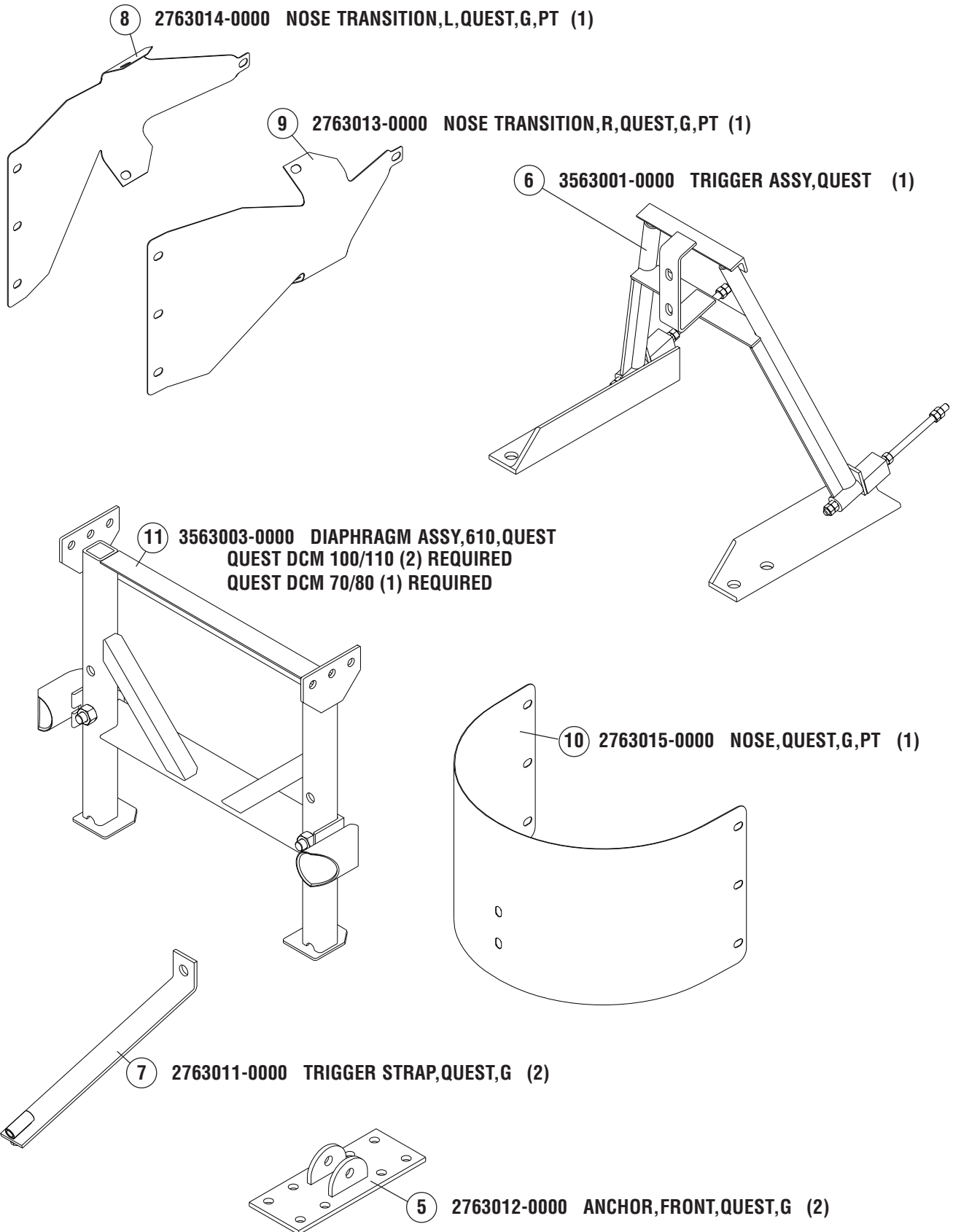
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QUEST CEN 70/80
Model No. TD80CEN610

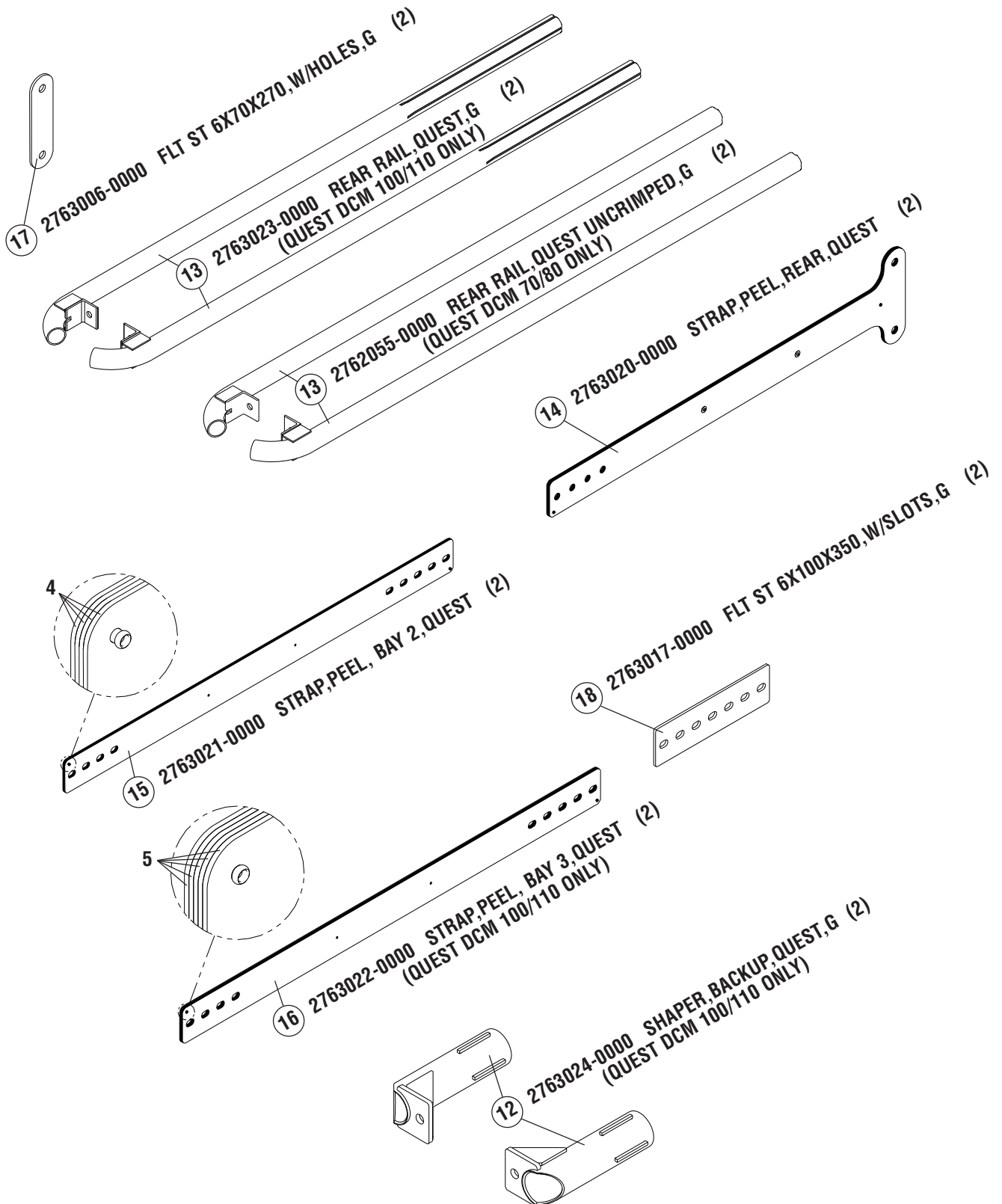
QUEST® DCM System



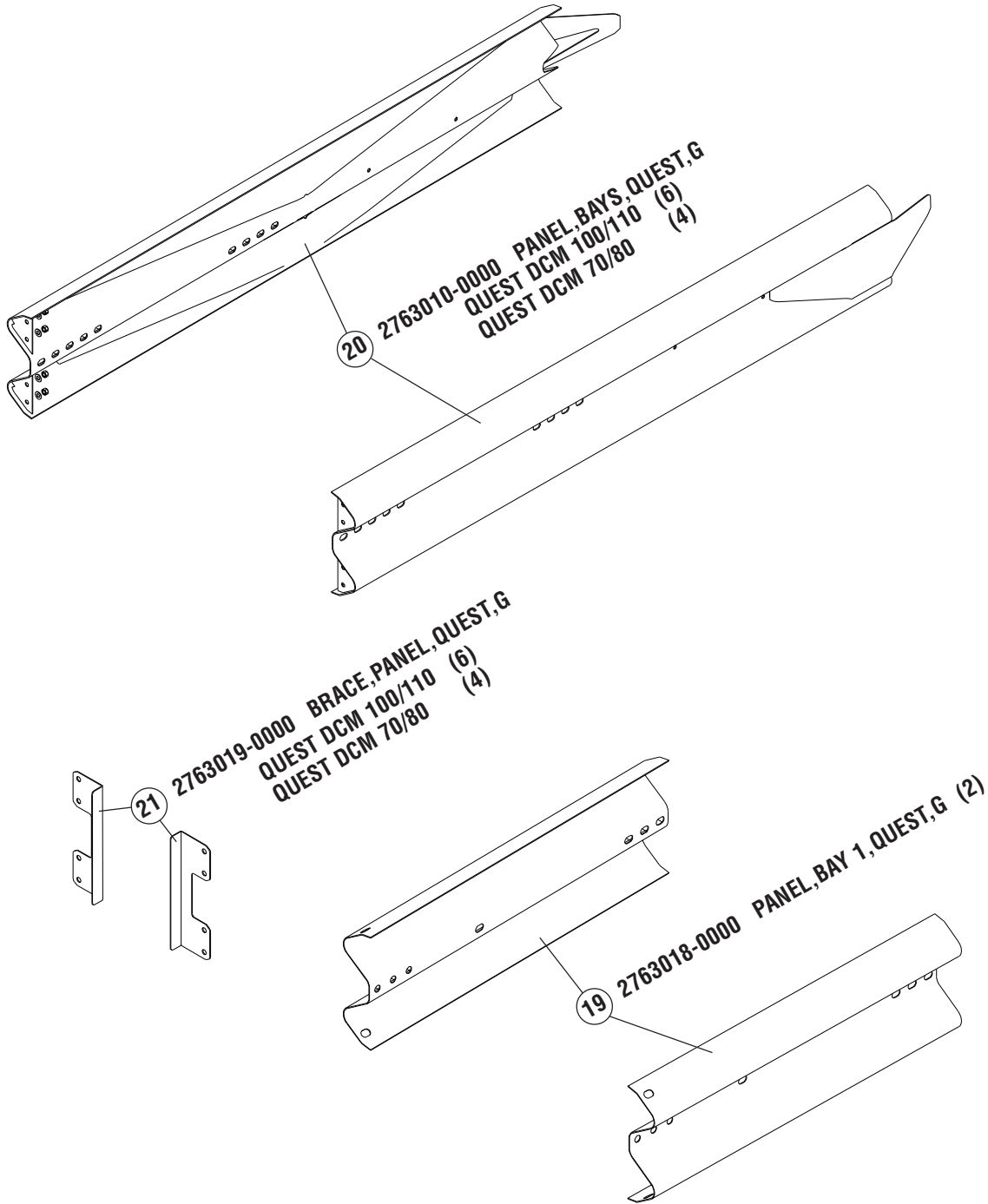
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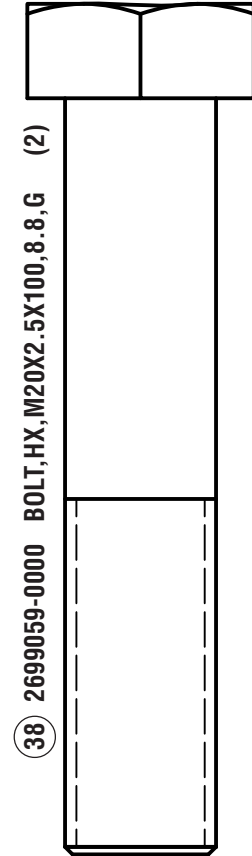
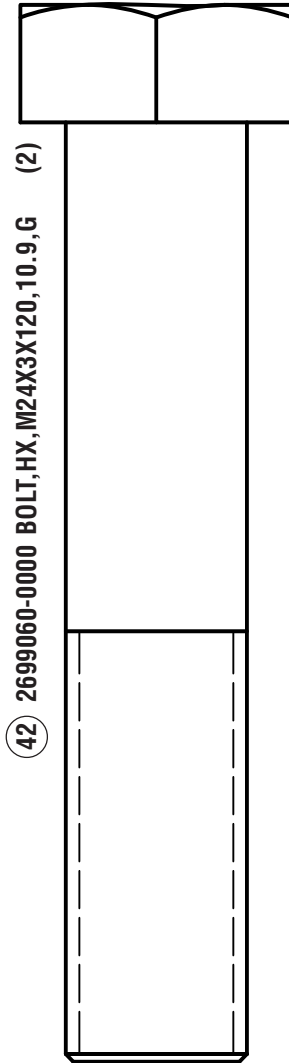
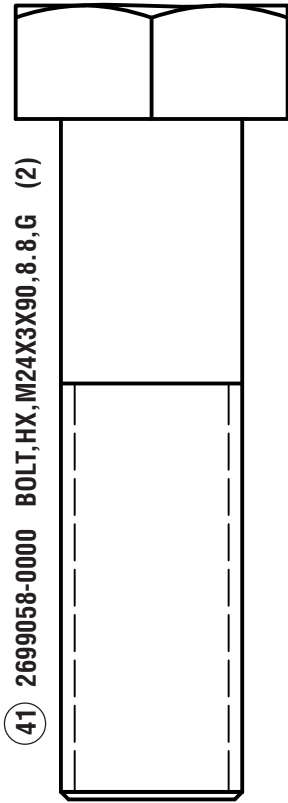
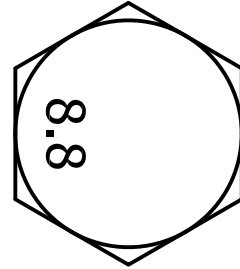
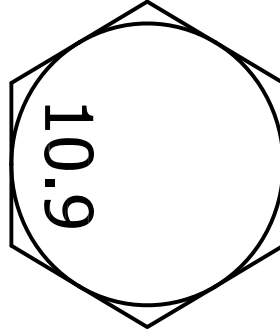
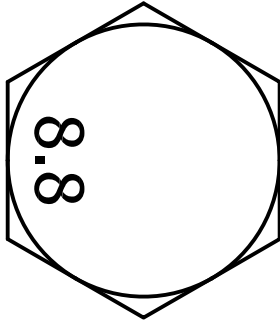
QUEST® DCM System



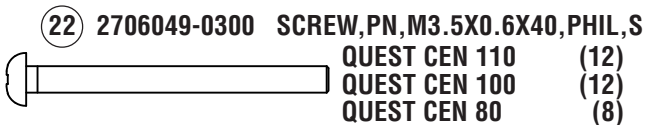
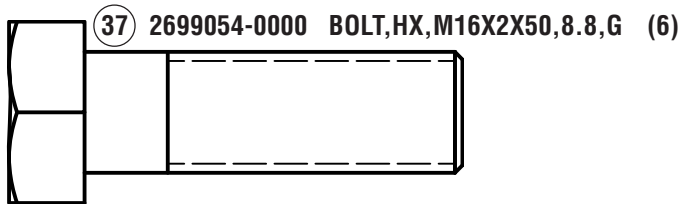
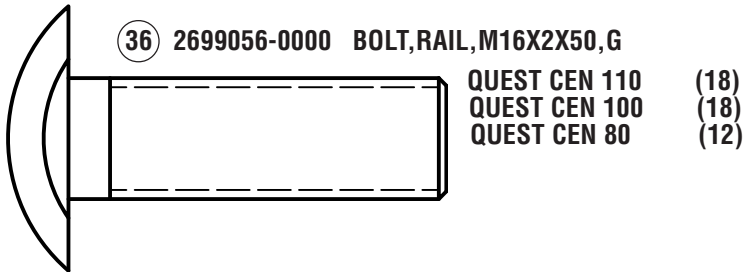
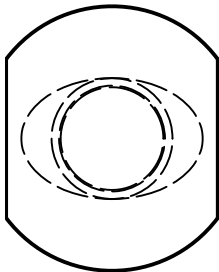
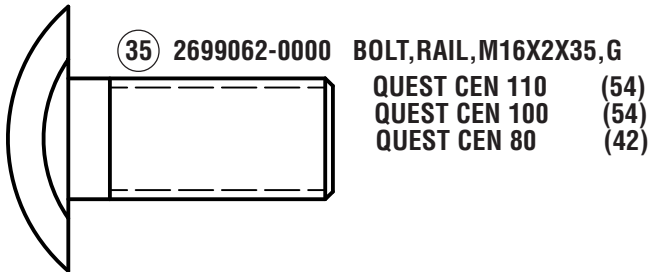
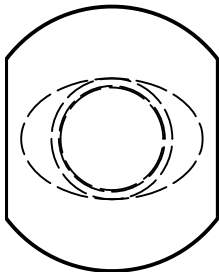
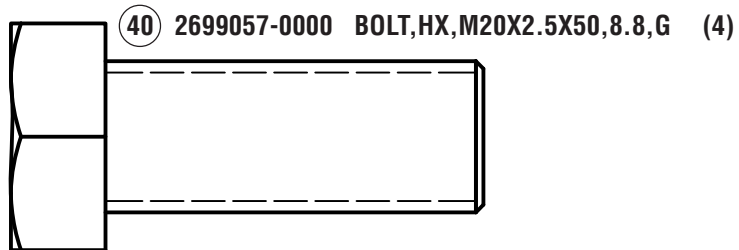
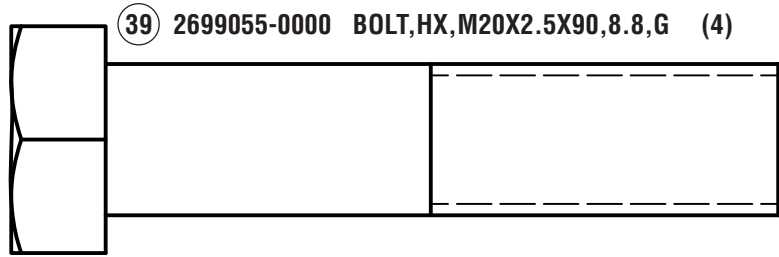
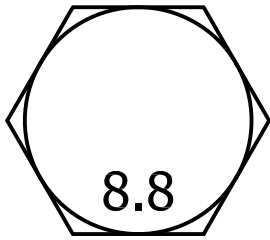
QUEST® DCM System



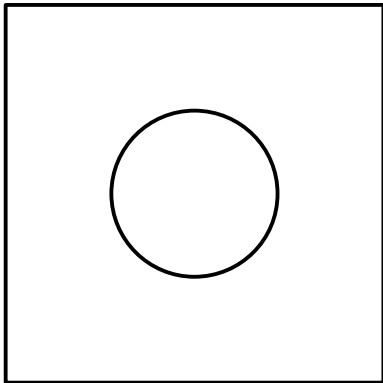
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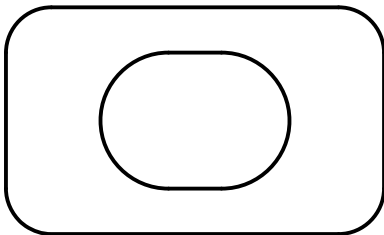
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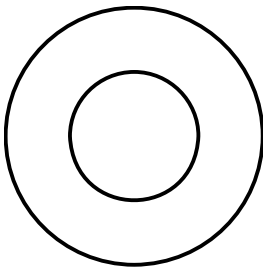
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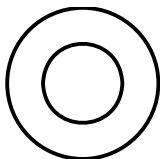
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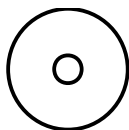
②⑥ 2708051-1000 WASHER,BAR,50X30X6,ROUNDED,G (8)



②⑤ 2708050-0000 WASHER,FLAT,M16,G (6)

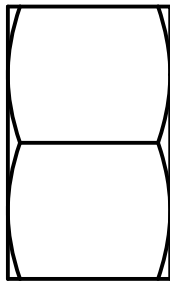
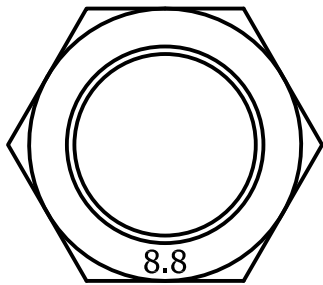


②④ 2708047-0100 WASHER,FLAT,M10,P
 QUEST CEN 110 (49)
 QUEST CEN 100 (48)
 QUEST CEN 80 (32)

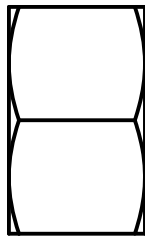
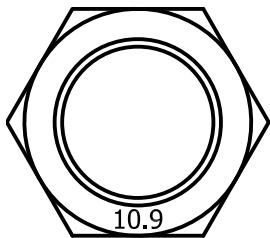


②⑦ 2708048-0300 WASHER,FLAT,M3.5,S
 QUEST CEN 110 (24)
 QUEST CEN 100 (24)
 QUEST CEN 80 (16)

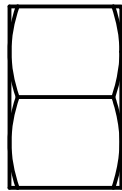
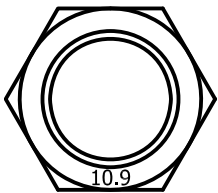
QUEST® DCM System



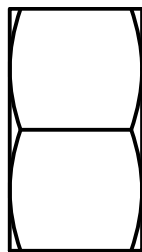
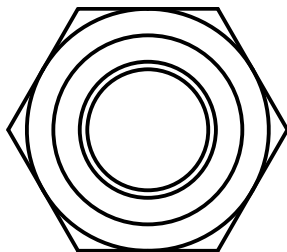
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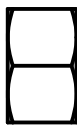
③① 2704924-0000 NUT,HX,M20X2.5,10.9,G (10)



③③ 2704925-0000 NUT,HX,M16X2,10.9,G (6)



③④ 2704923-0000 NUT,HX,M16X2,RAIL,G
 QUEST CEN 110 (72)
 QUEST CEN 100 (72)
 QUEST CEN 80 (54)



③⑤ 2704921-0000 NUT,HX,M10X1.5,8.8,G
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 QUEST CEN 100 (24)
 QUEST CEN 80 (16)

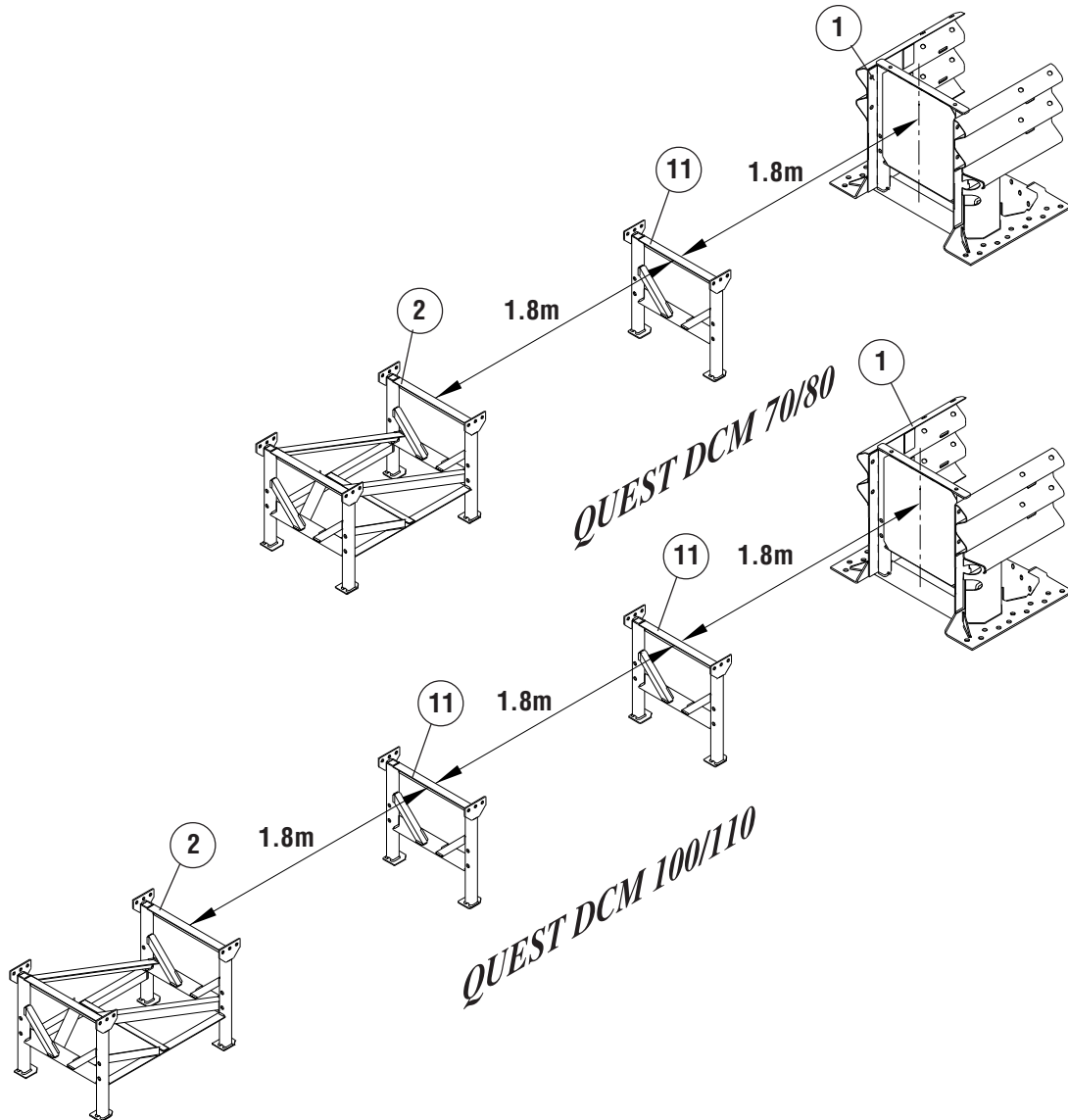


③⑥ 2704772-0300 NUT,HX,#6-32,S
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 QUEST CEN 100 (24)
 QUEST CEN 80 (16)

QUEST[®] DCM System

Assembly

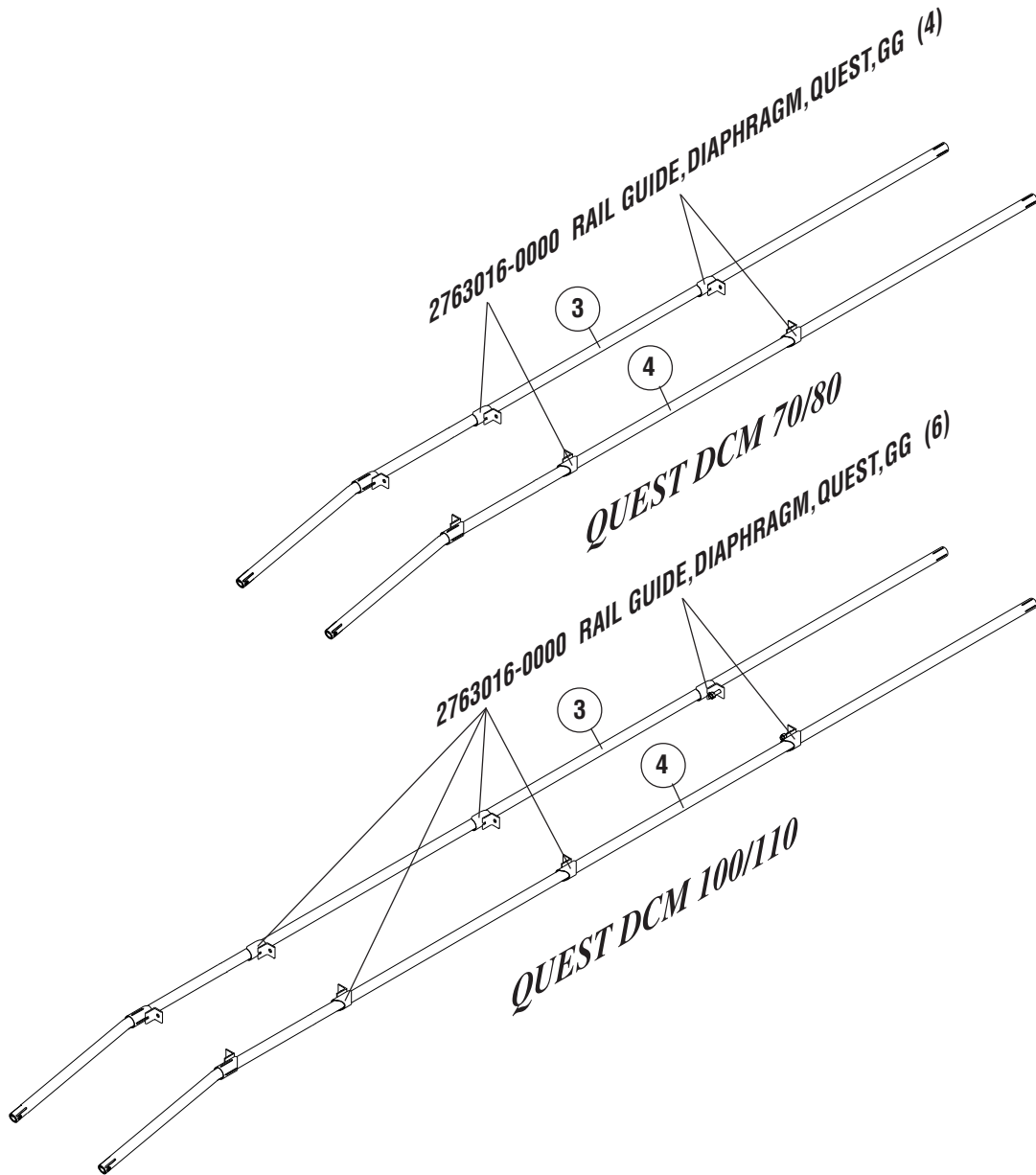
Step 1



QUEST® DCM System

Assembly (cont'd.)

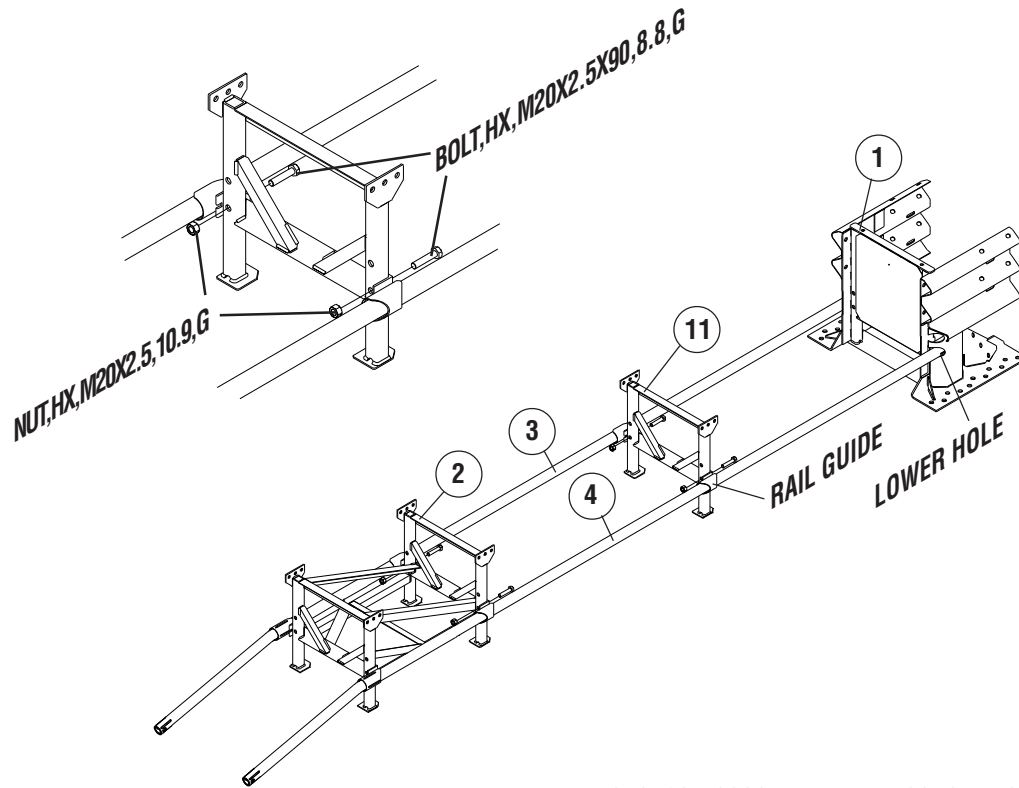
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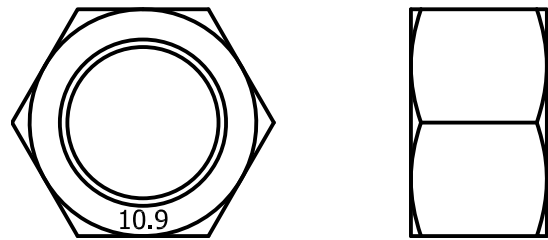
QUEST® DCM System

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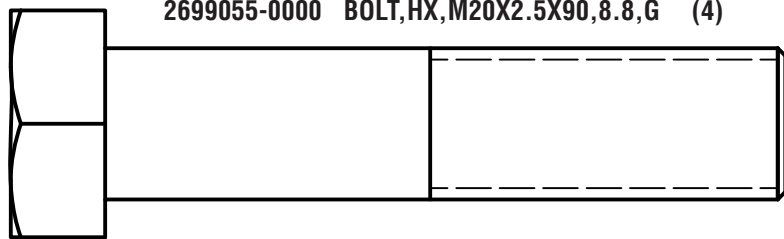
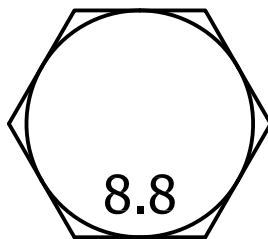
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2704924-0000 NUT, HX, M20X2.5, 10.9, G (4)



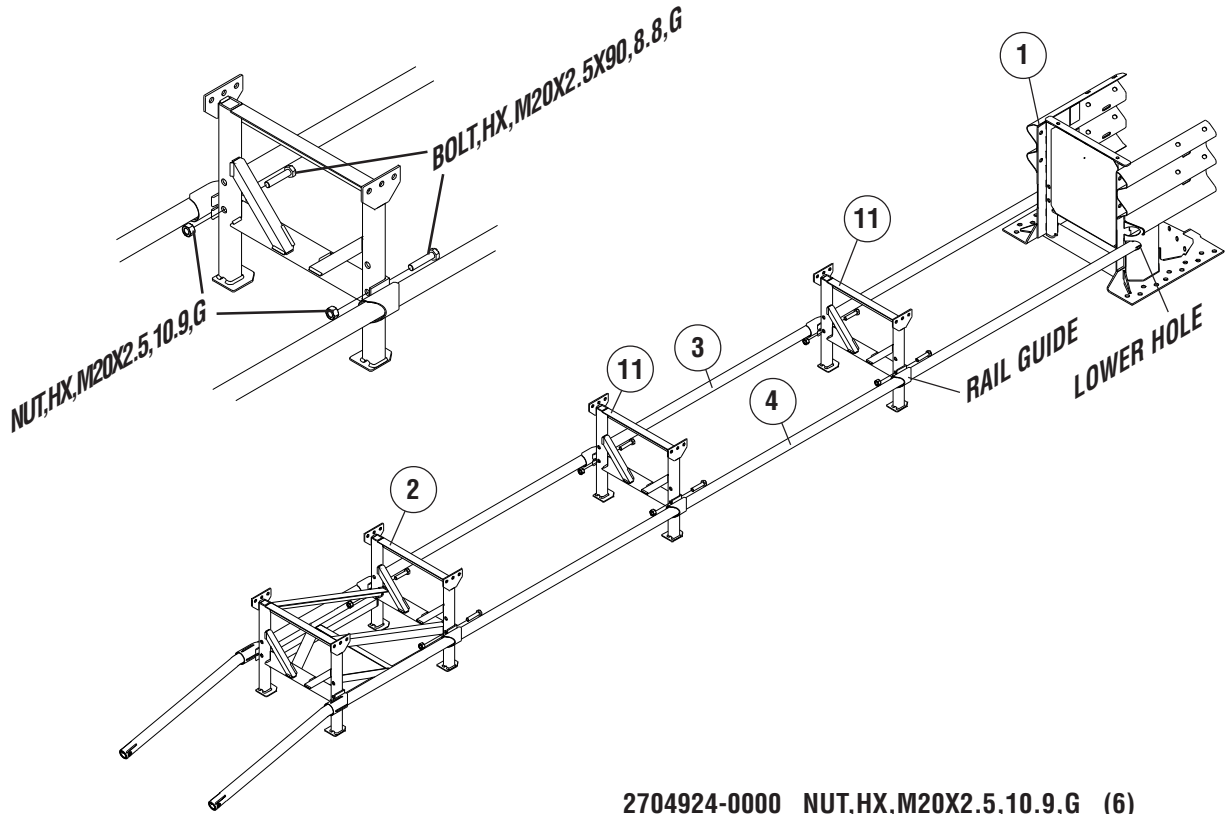
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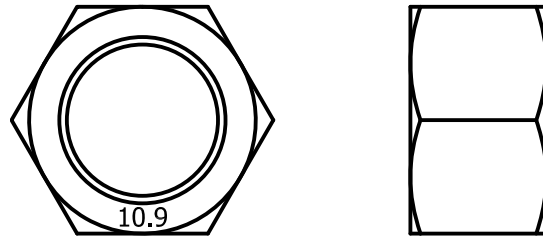
QUEST® DCM System

Assembly (cont'd.)

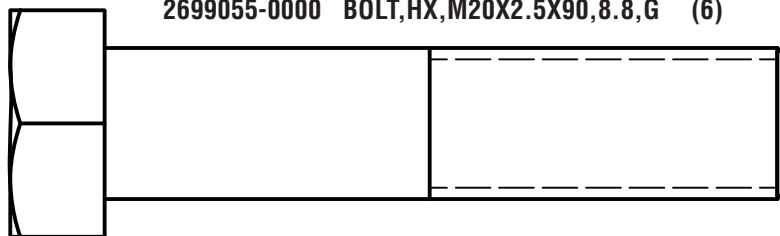
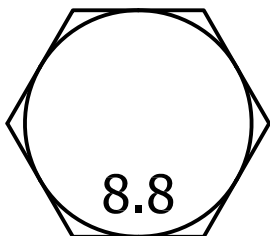
Step 3 (QUEST DCM 100/110)



2704924-0000 NUT, HX, M20X2.5, 10.9, G (6)



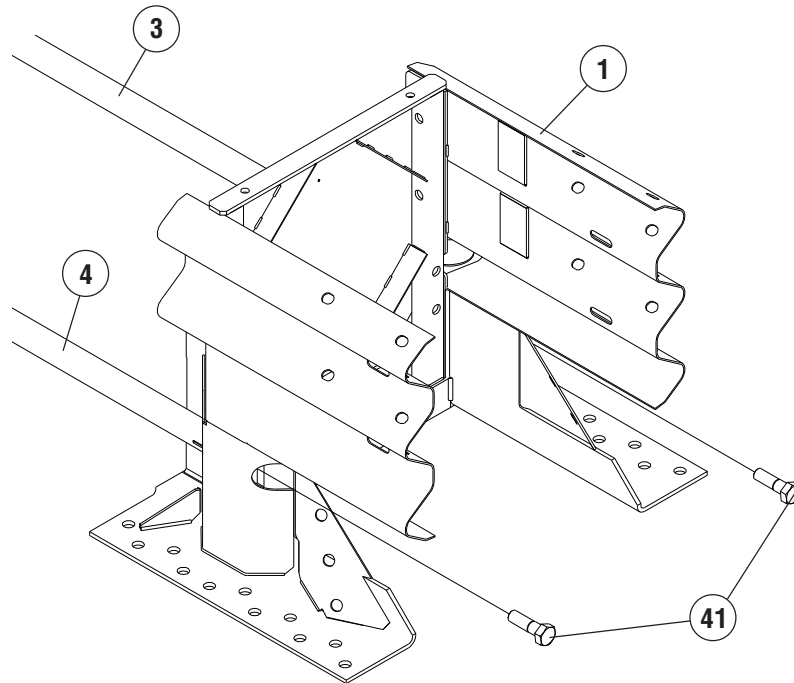
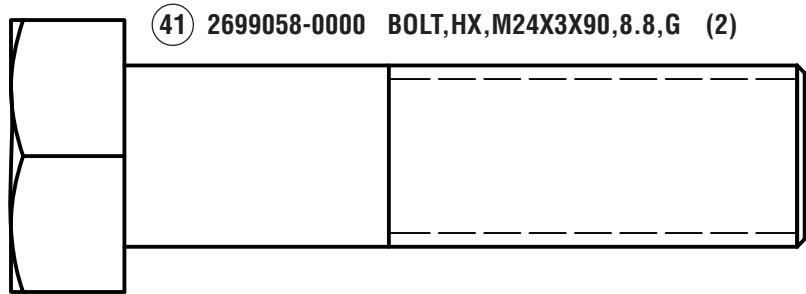
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QUEST[®] DCM System

Assembly (cont'd.)

Step 4

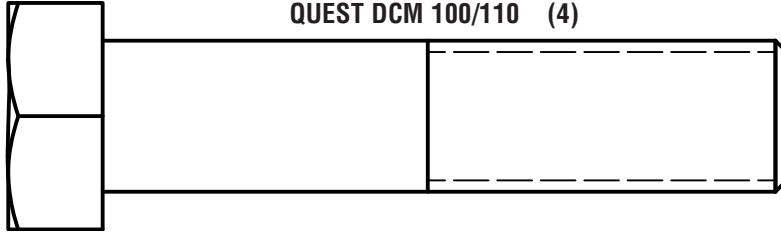
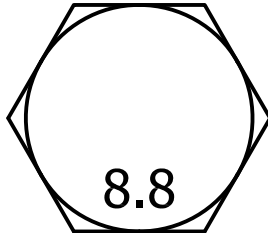


QUEST[®] DCM System

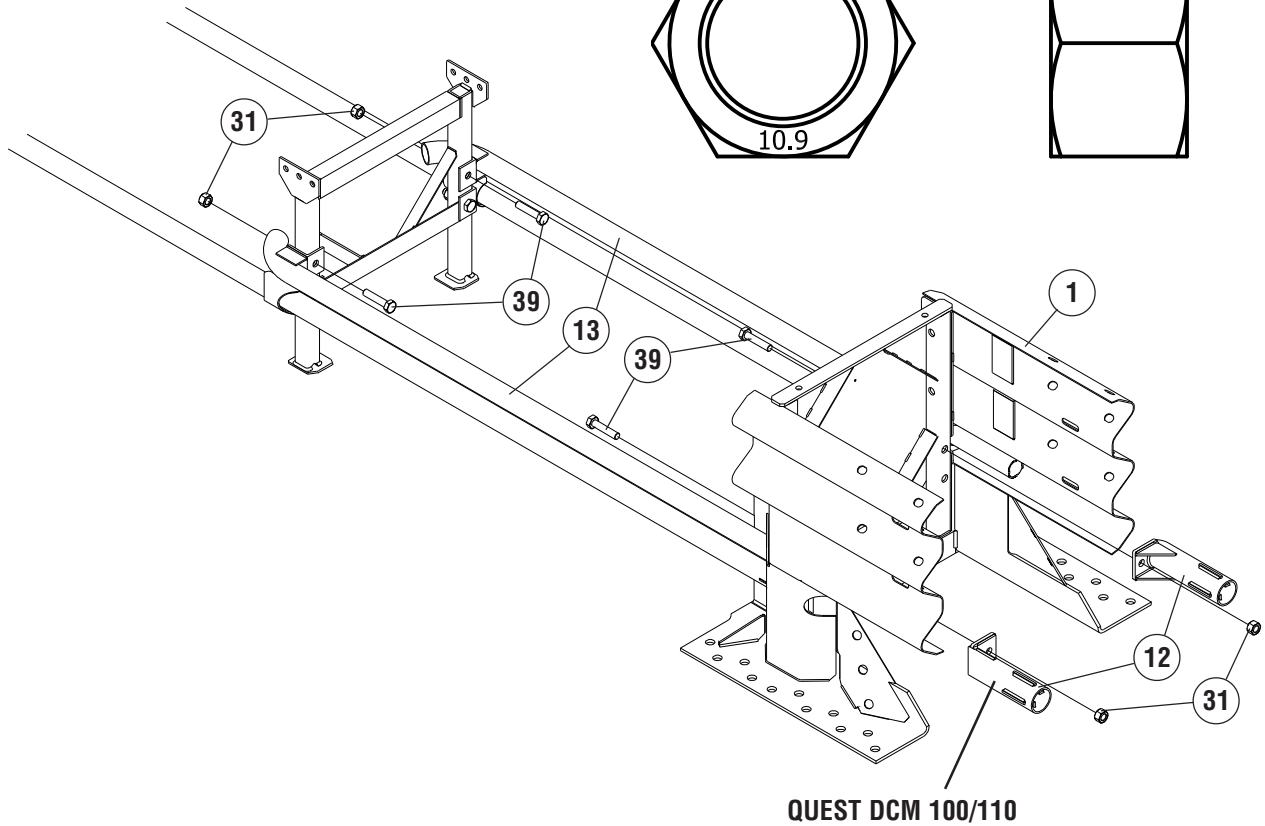
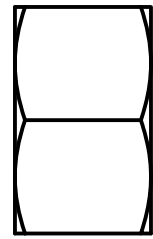
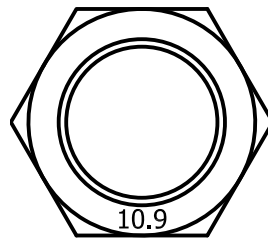
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Step 5

- ③⑨ 2699055-0000 BOLT, HX, M20X2.5X90, 8.8, G
QUEST DCM 70/80 (2)
QUEST DCM 100/110 (4)



- ③① 2704924-0000 NUT, HX, M20X2.5, 10.9, G
QUEST DCM 70/80 (2)
QUEST DCM 100/110 (4)

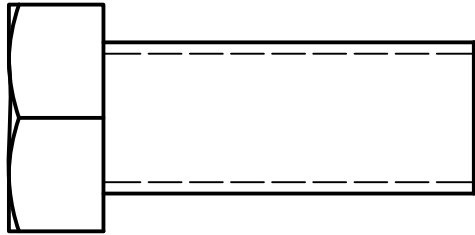
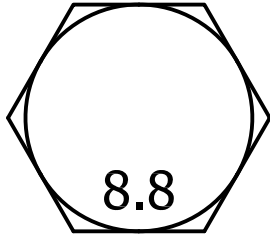


QUEST[®] DCM System

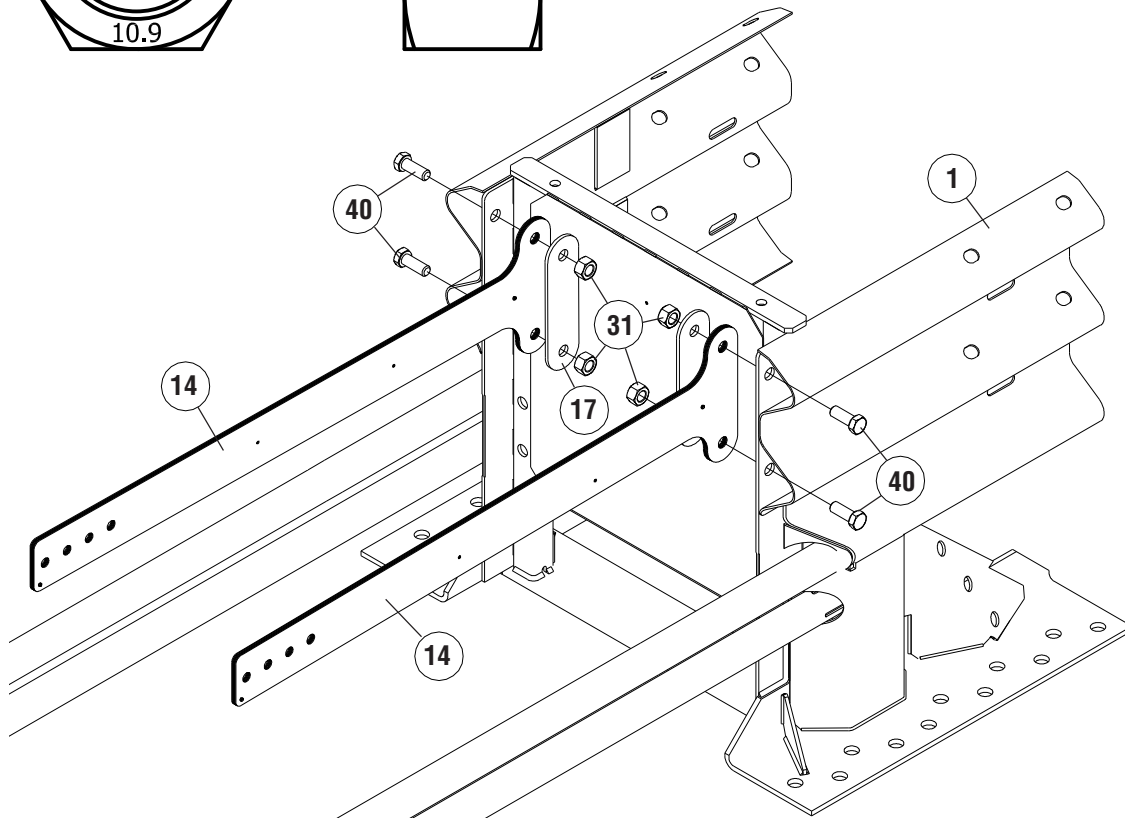
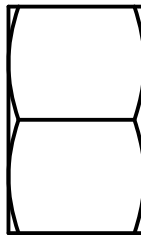
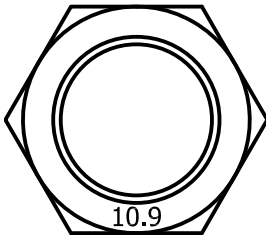
Assembly (cont'd.)

Step 6

④① 2699057-0000 BOLT,HX,M20X2.5X50,8.8,G (4)



③① 2704924-0000 NUT,HX,M20X2.5,10.9,G (4)



QUEST® DCM System

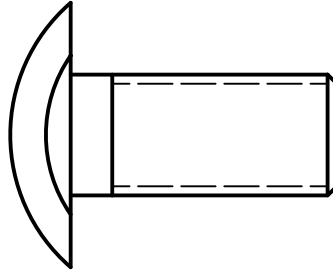
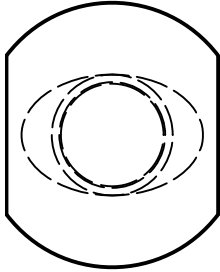
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QUEST® DCM System

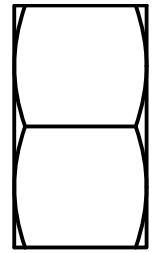
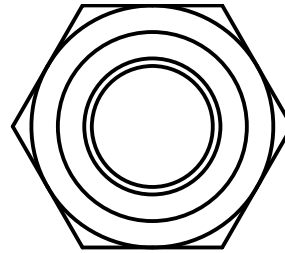
Assembly (cont'd.)

Step 7

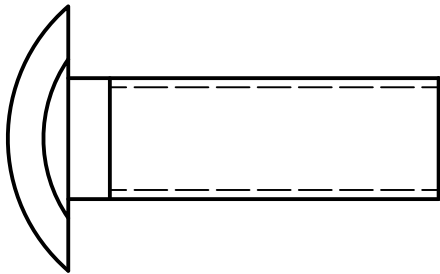
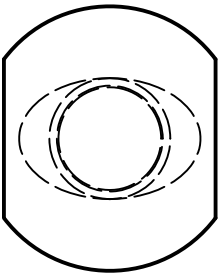
35 2699062-0000 BOLT,RAIL,M16X2X35,G (10)



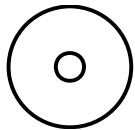
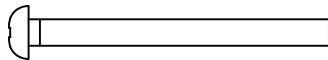
29 2704923-0000 NUT,HX,M16X2,RAIL,G (18)



36 2699056-0000 BOLT,RAIL,M16X2X50,G (6)



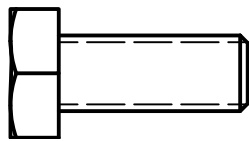
22 2706049-0300 SCREW,PN,M3.5X0.6X40,PHIL,S (4)



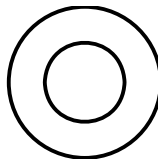
27 2708048-0300 WASHER,FLAT,M3.5,S (8)



33 2704772-0300 NUT,HX,#6-32,S (8)



34 2699061-0000 BOLT,HX,M10X1.5X25,8.8,G (8)



24 2708047-0100 WASHER,FLAT,M10,P (16)

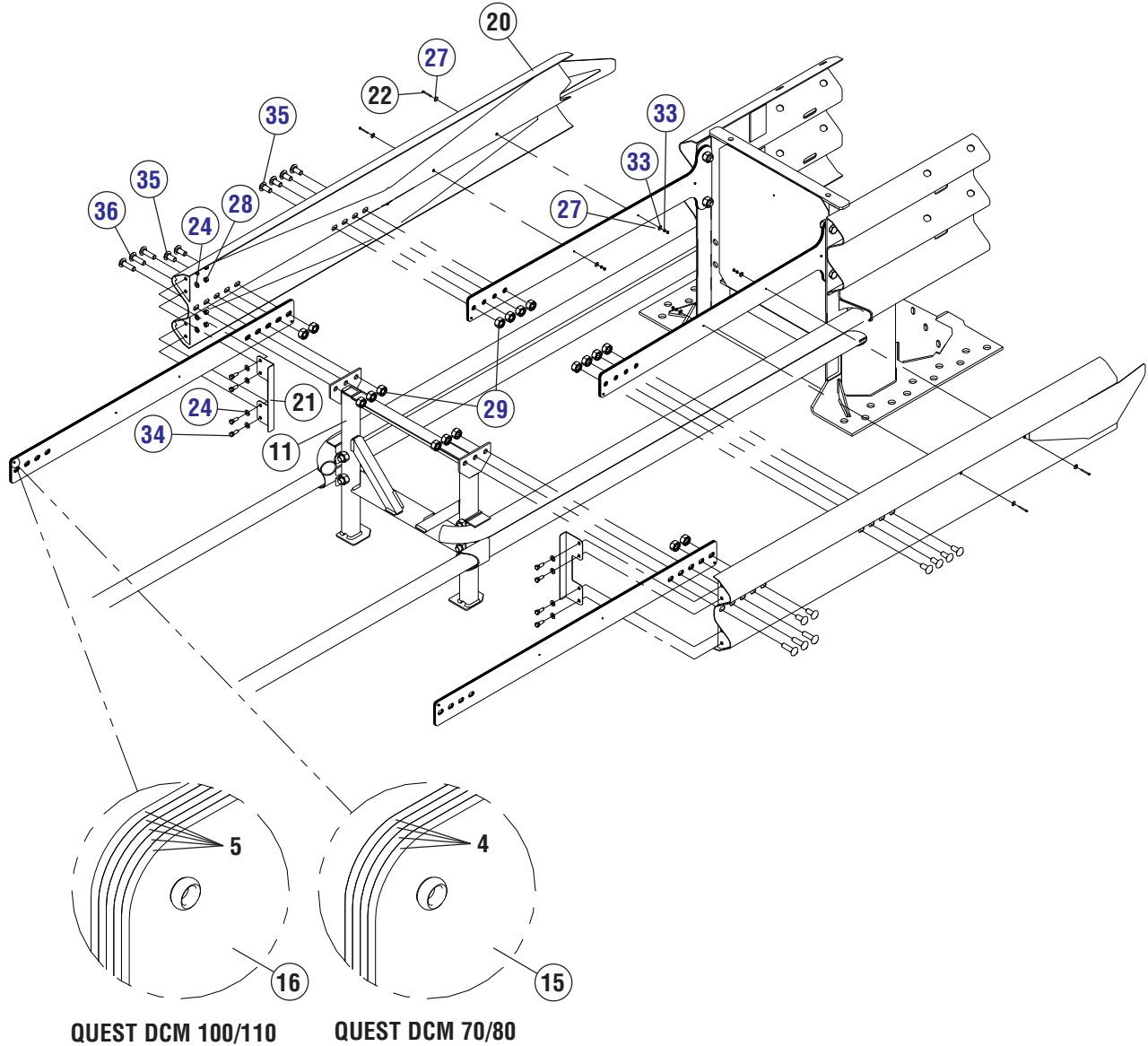


28 2704921-0000 NUT,HX,M10X1.5,8.8,G (8)

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Assembly (cont'd.)

Step 7 (cont'd.)

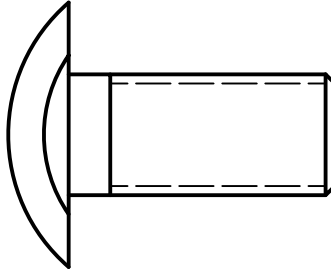
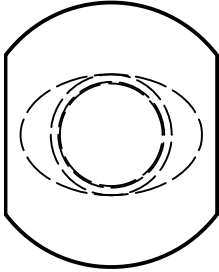


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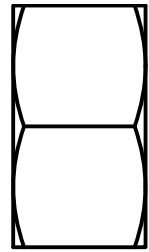
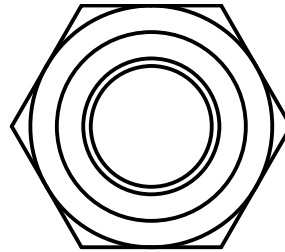
Assembly (cont'd.)

Step 8 (QUEST DCM 70/80, Skip this step)

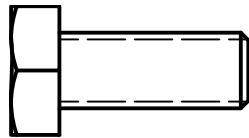
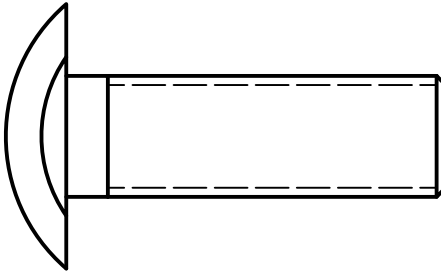
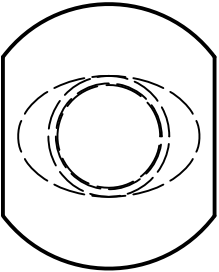
③⑤ 2699062-0000 BOLT,RAIL,M16X2X35,G (12)



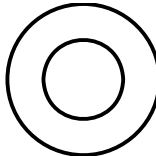
②⑨ 2704923-0000 NUT,HX,M16X2,RAIL,G (18)



③⑥ 2699056-0000 BOLT,RAIL,M16X2X50,G (6)



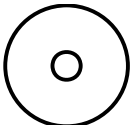
③④ 2699061-0000 BOLT,HX,M10X1.5X25,8.8,G (8)



②④ 2708047-0100 WASHER,FLAT,M10,P (16)



②⑧ 2704921-0000 NUT,HX,M10X1.5,8.8,G (8)



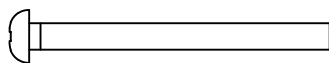
②⑦ 2708048-0300 WASHER,FLAT,M3.5,S (8)



③③ 2704772-0300 NUT,HX,#6-32,S (8)



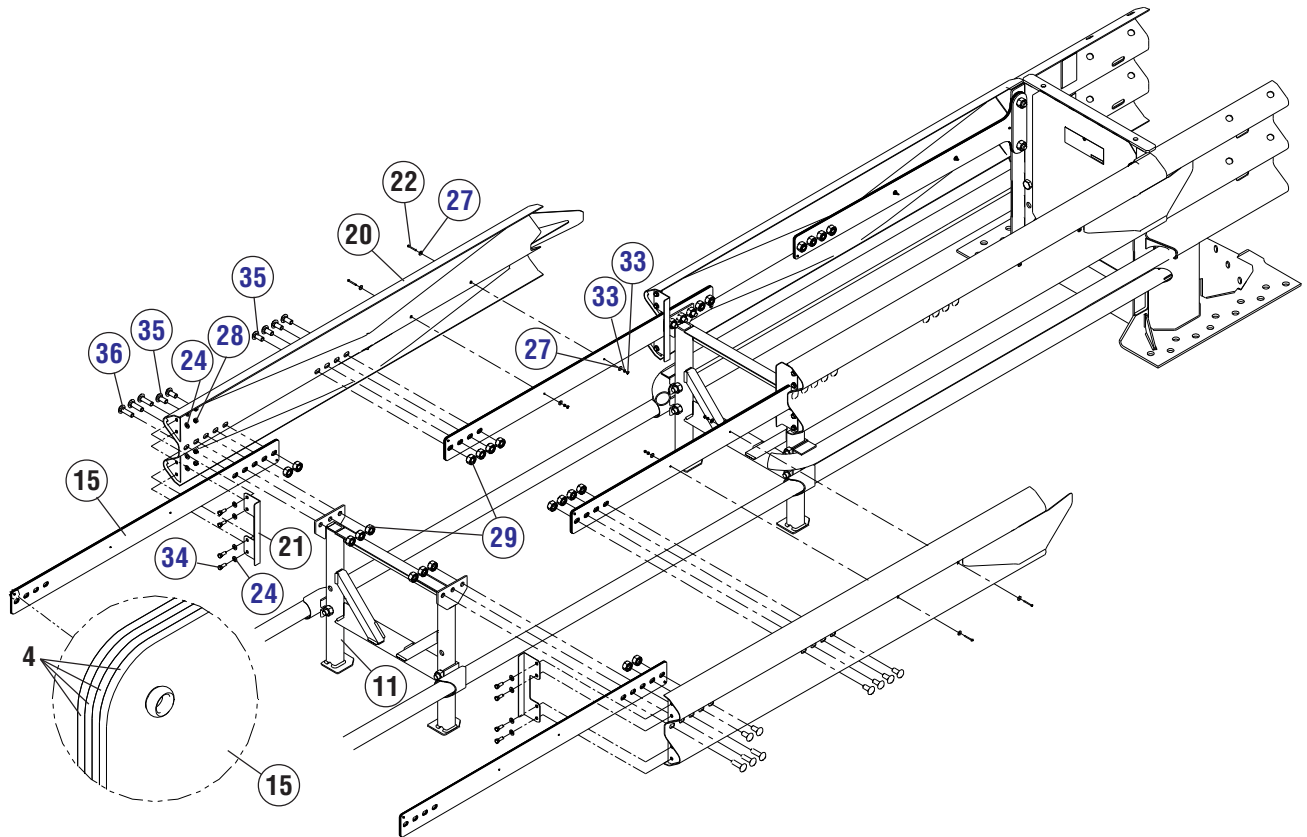
②② 2706049-0300 SCREW,PN,M3.5X0.6X40,PHIL,S (4)



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Assembly (cont'd.)

Step 8 (cont'd.) (QUEST DCM 70/80, Skip this step)

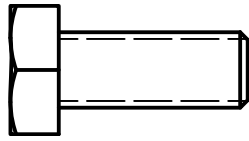


QUEST DCM 100/110

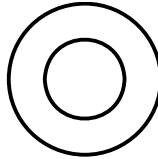
QUEST® DCM System

Assembly (cont'd.)

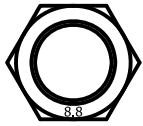
Step 9 (x2)



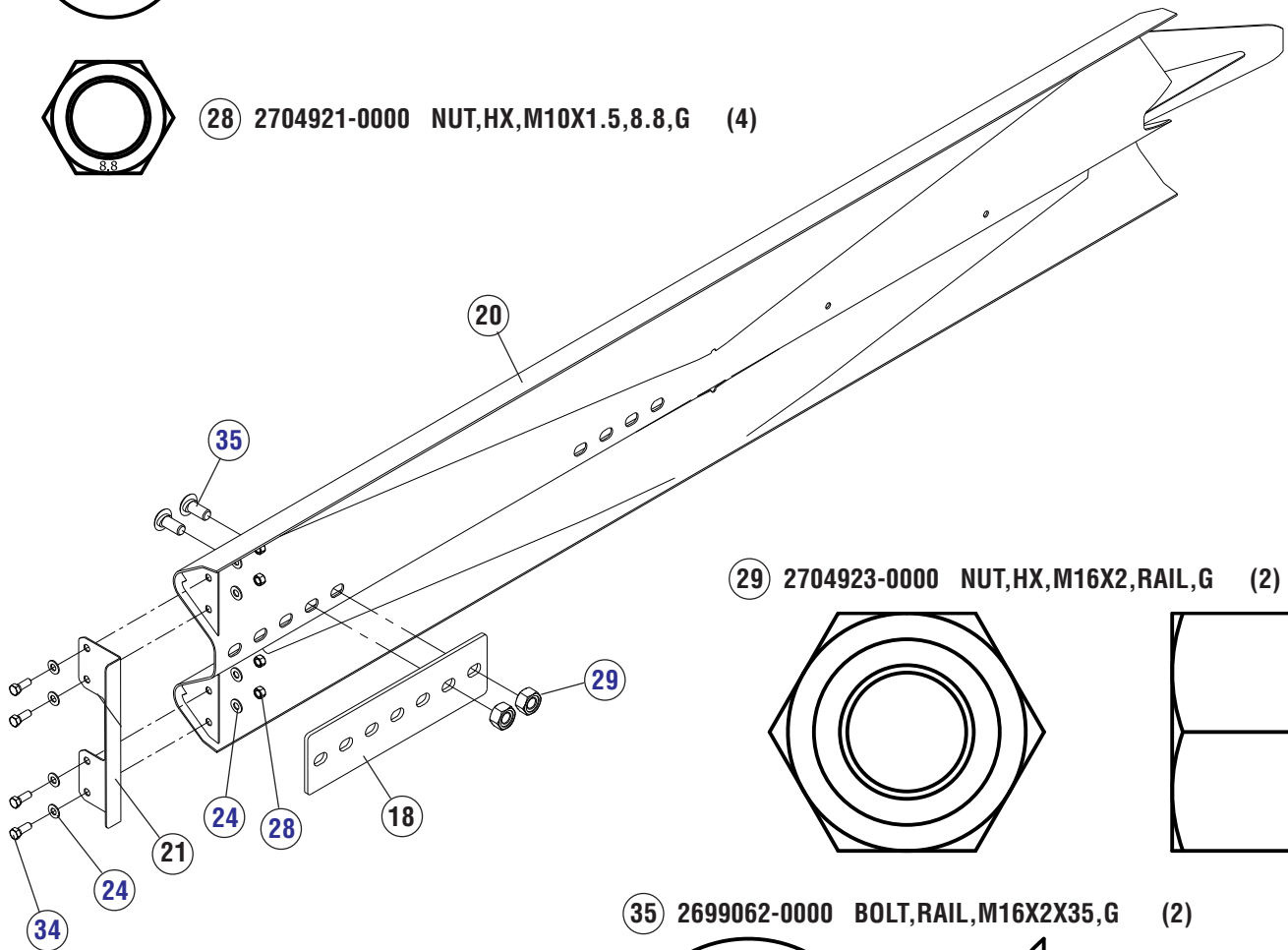
34 2699061-0000 BOLT,HX,M10X1.5X25,8.8,G (4)



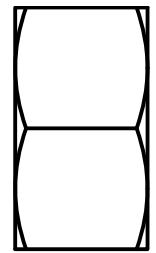
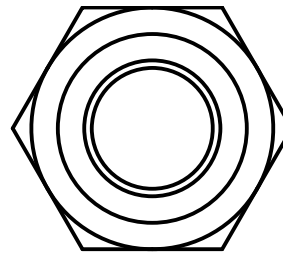
24 2708047-0100 WASHER,FLAT,M10,P (8)



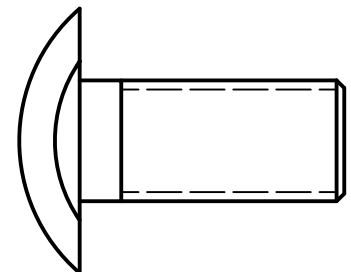
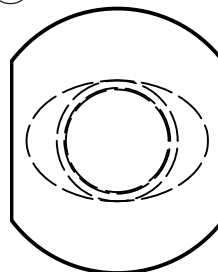
28 2704921-0000 NUT,HX,M10X1.5,8.8,G (4)



29 2704923-0000 NUT,HX,M16X2,RAIL,G (2)



35 2699062-0000 BOLT,RAIL,M16X2X35,G (2)

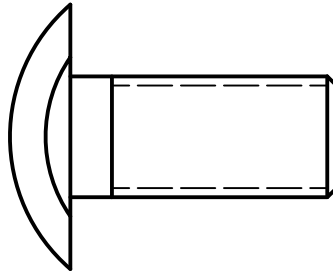
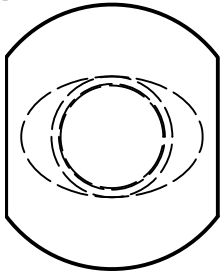


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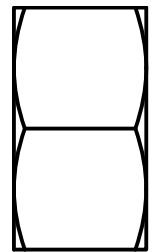
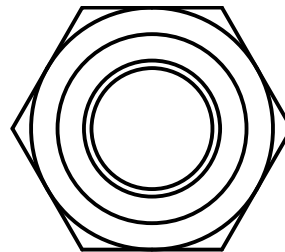
Assembly (cont'd.)

Step 10

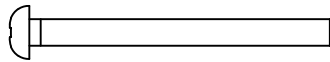
③⑤ 2699062-0000 BOLT,RAIL,M16X2X35,G (8)



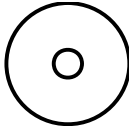
②⑨ 2704923-0000 NUT,HX,M16X2,RAIL,G (12)



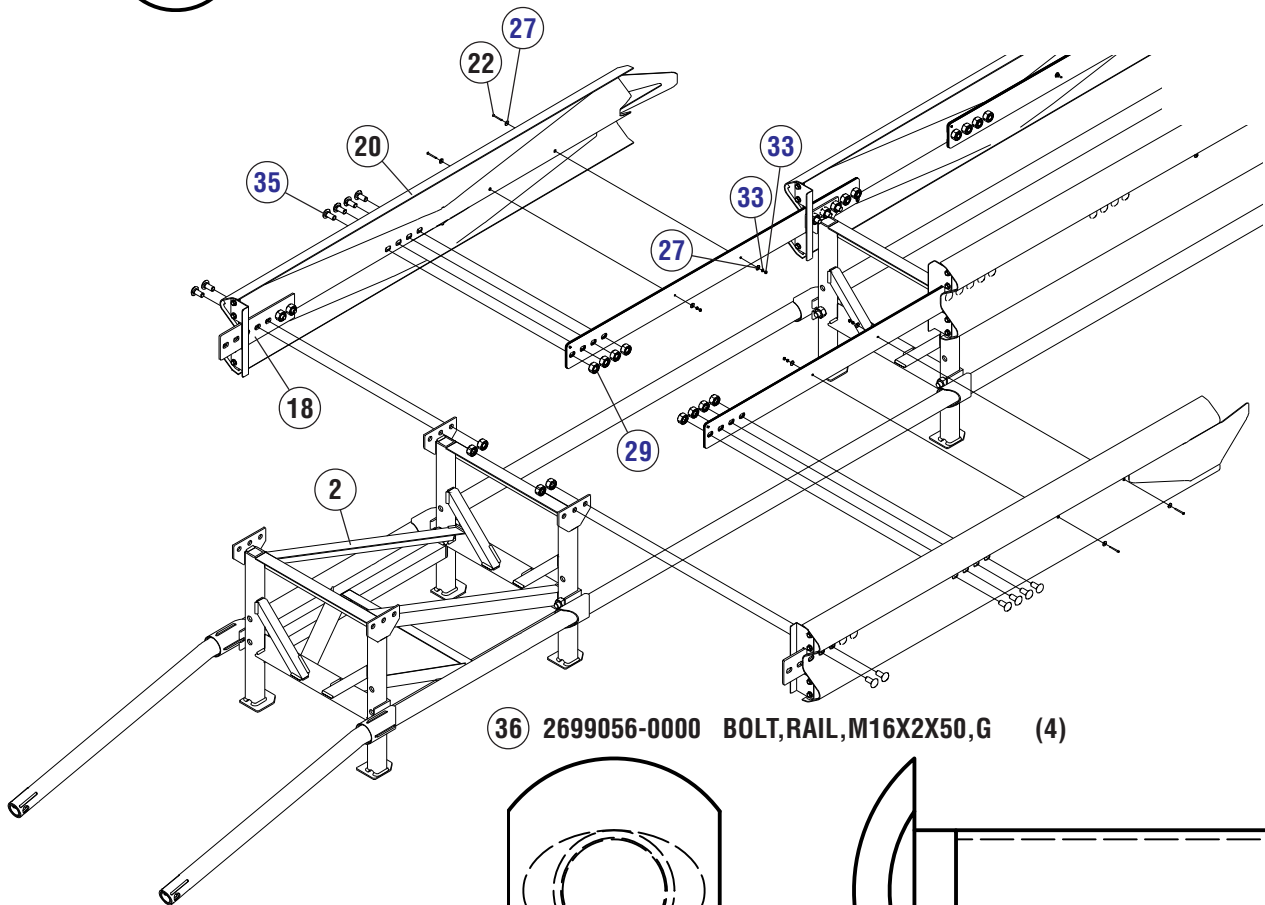
②② 2706049-0300 SCREW,PN,M3.5X0.6X40,PHIL,S (4)



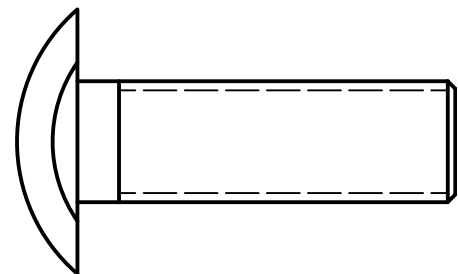
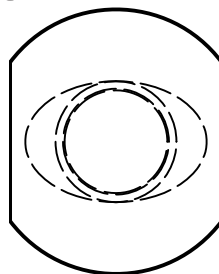
③③ 2704772-0300 NUT,HX,#6-32,S (8)



②⑦ 2708048-0300 WASHER,FLAT,M3.5,S (8)



③⑥ 2699056-0000 BOLT,RAIL,M16X2X50,G (4)



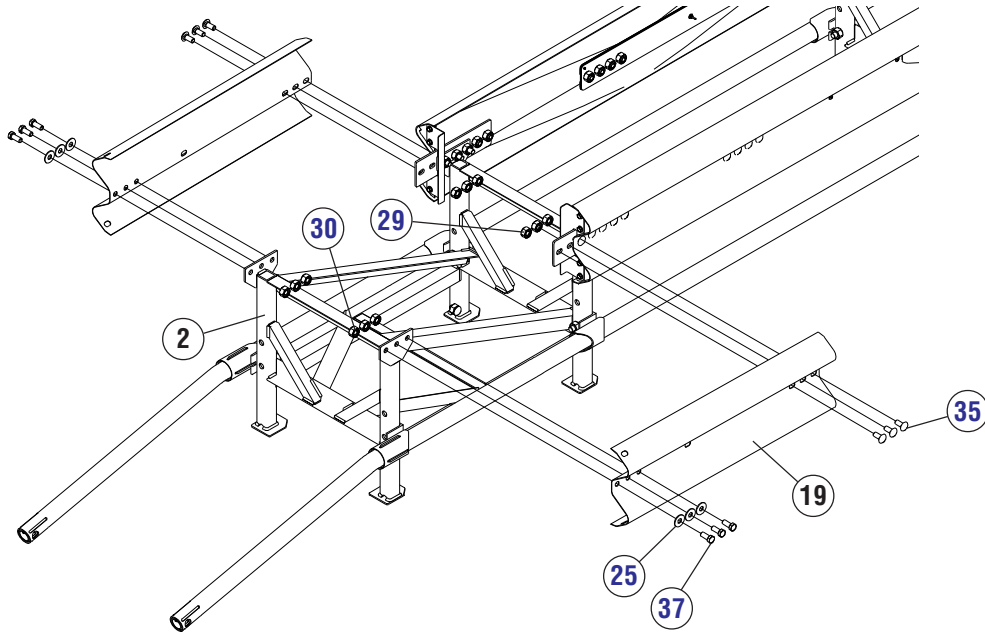
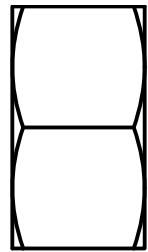
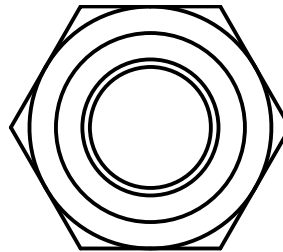
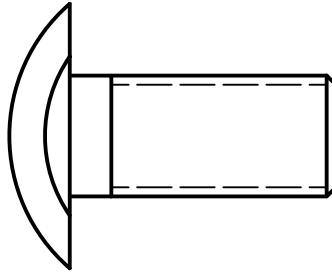
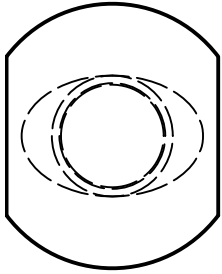
QUEST® DCM System

Assembly (cont'd.)

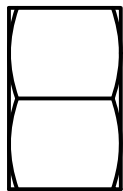
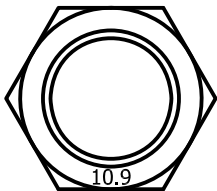
Step 11

35 2699062-0000 BOLT,RAIL,M16X2X35,G (6)

29 2704923-0000 NUT,HX,M16X2,RAIL,G (6)

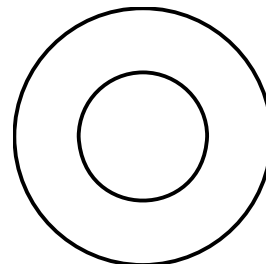
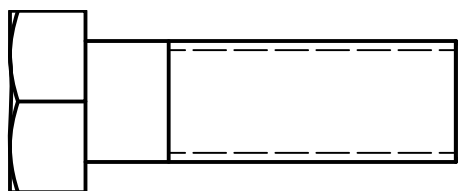


30 2704925-0000 NUT,HX,M16X2,10.9,G (6)



25 2708050-0000 WASHER,FLAT,M16,G (6)

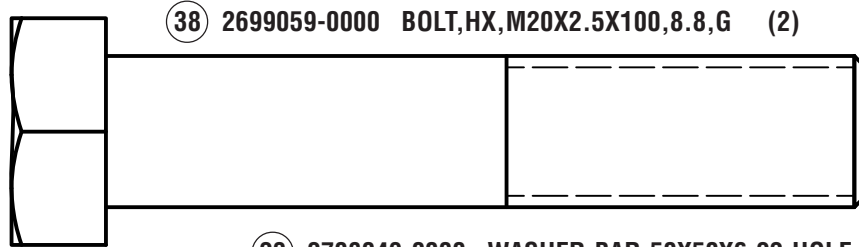
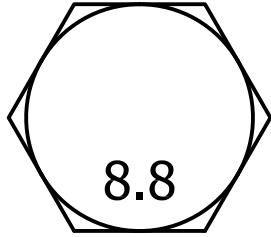
37 2699054-0000 BOLT,HX,M16X2X50,8.8,G (6)



QUEST® DCM System

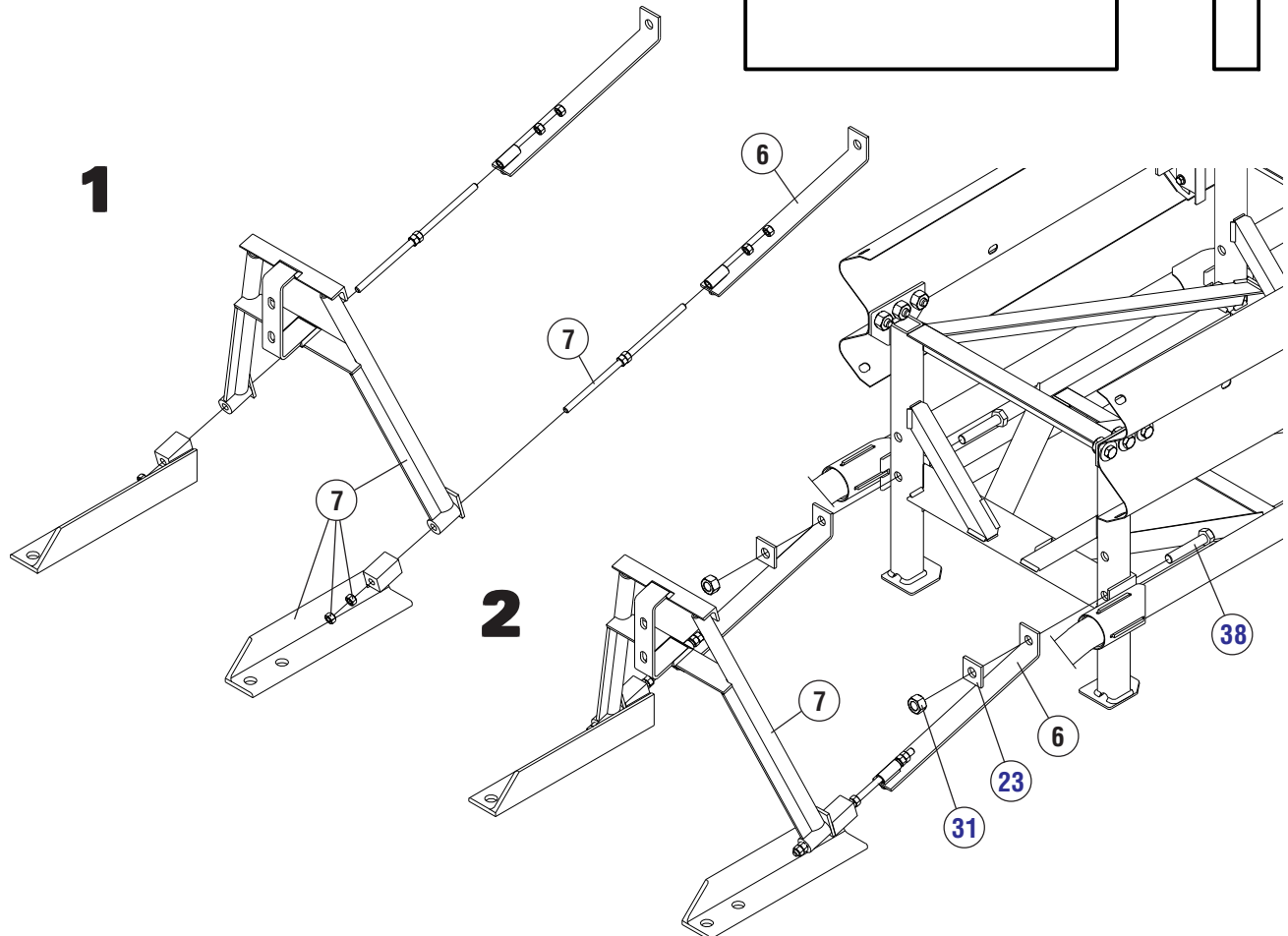
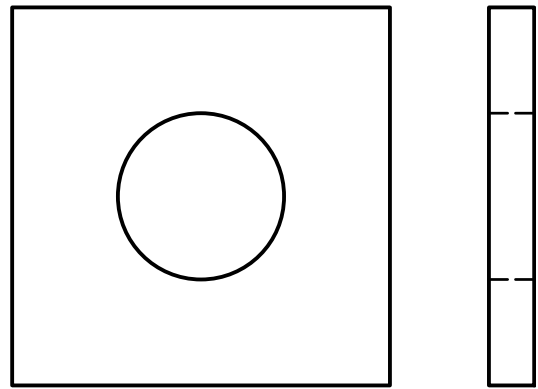
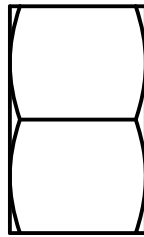
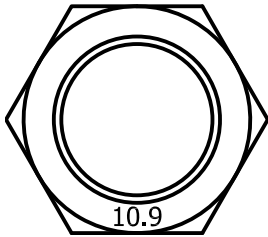
Assembly (cont'd.)

Step 12



23 2708049-0000 WASHER, BAR, 50X50X6, 22 HOLE, G (2)

31 2704924-0000 NUT, HX, M20X2.5, 10.9, G (2)

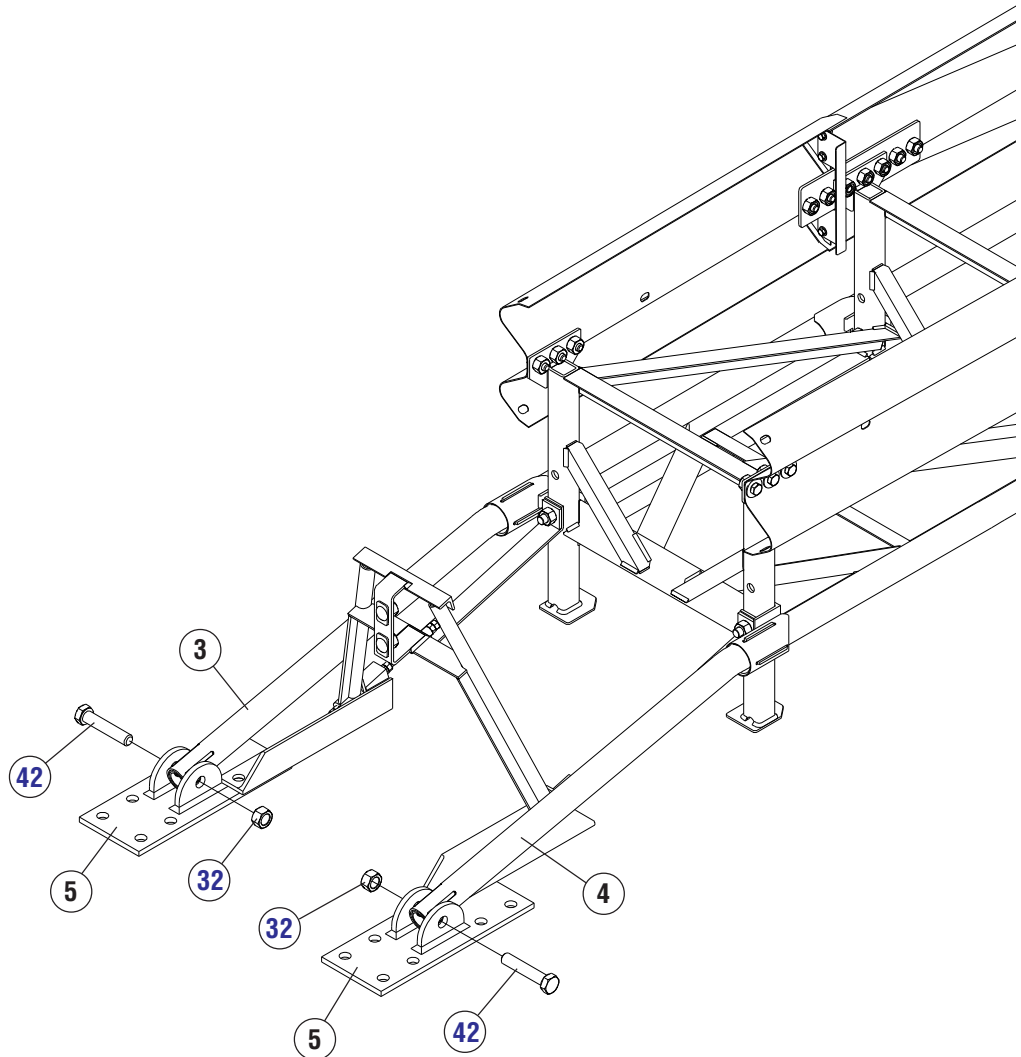
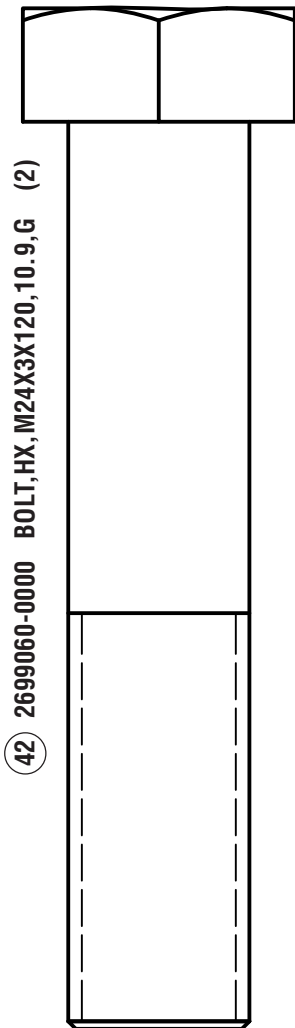
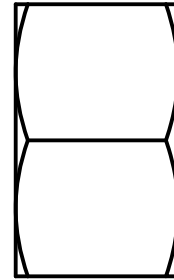
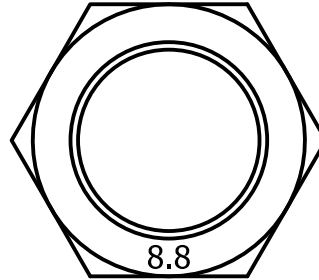
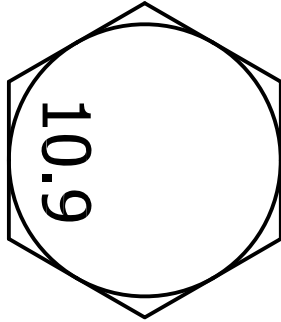


QUEST® DCM System

Assembly (cont'd.)

Step 13

32 2704922-0000 NUT, HX, M24X3, 8.8, G (2)



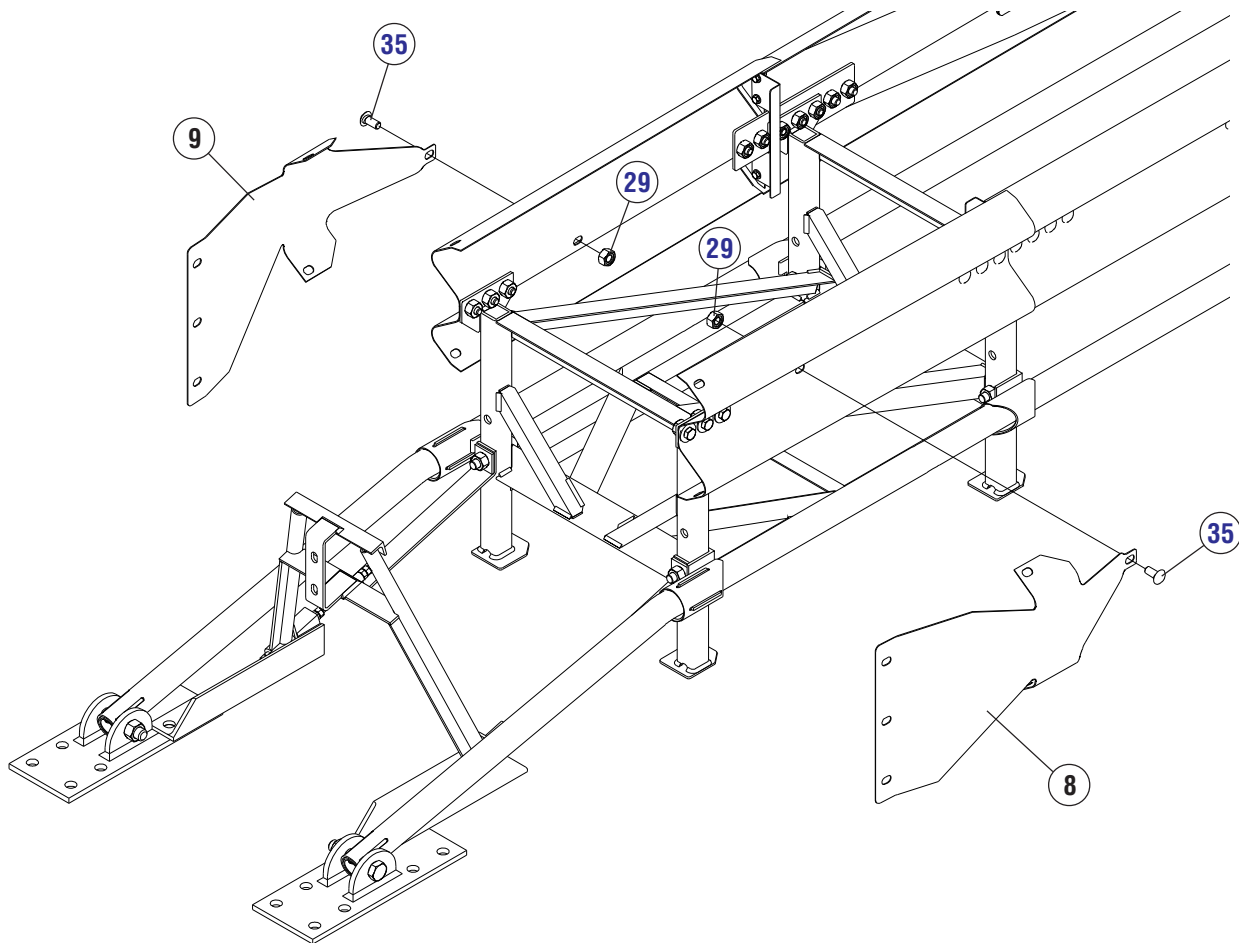
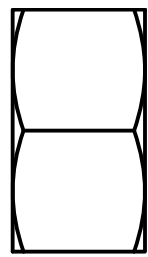
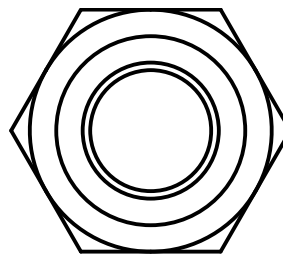
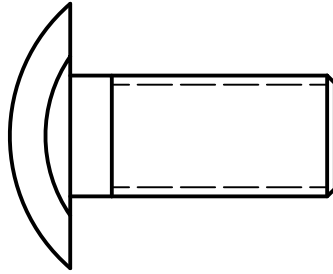
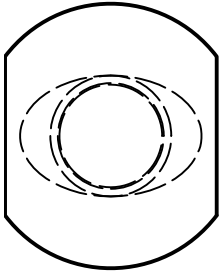
QUEST[®] DCM System

Assembly (cont'd.)

Step 14A

35 2699062-0000 BOLT,RAIL,M16X2X35,G (2)

29 2704923-0000 NUT,HX,M16X2,RAIL,G (2)

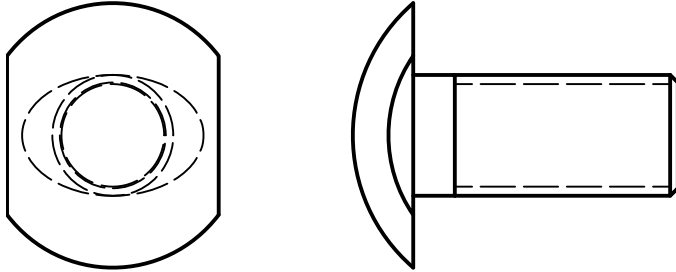


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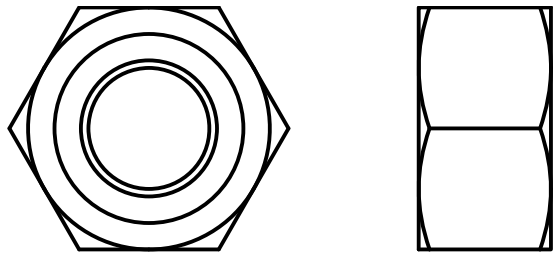
Assembly (cont'd.)

Step 14B

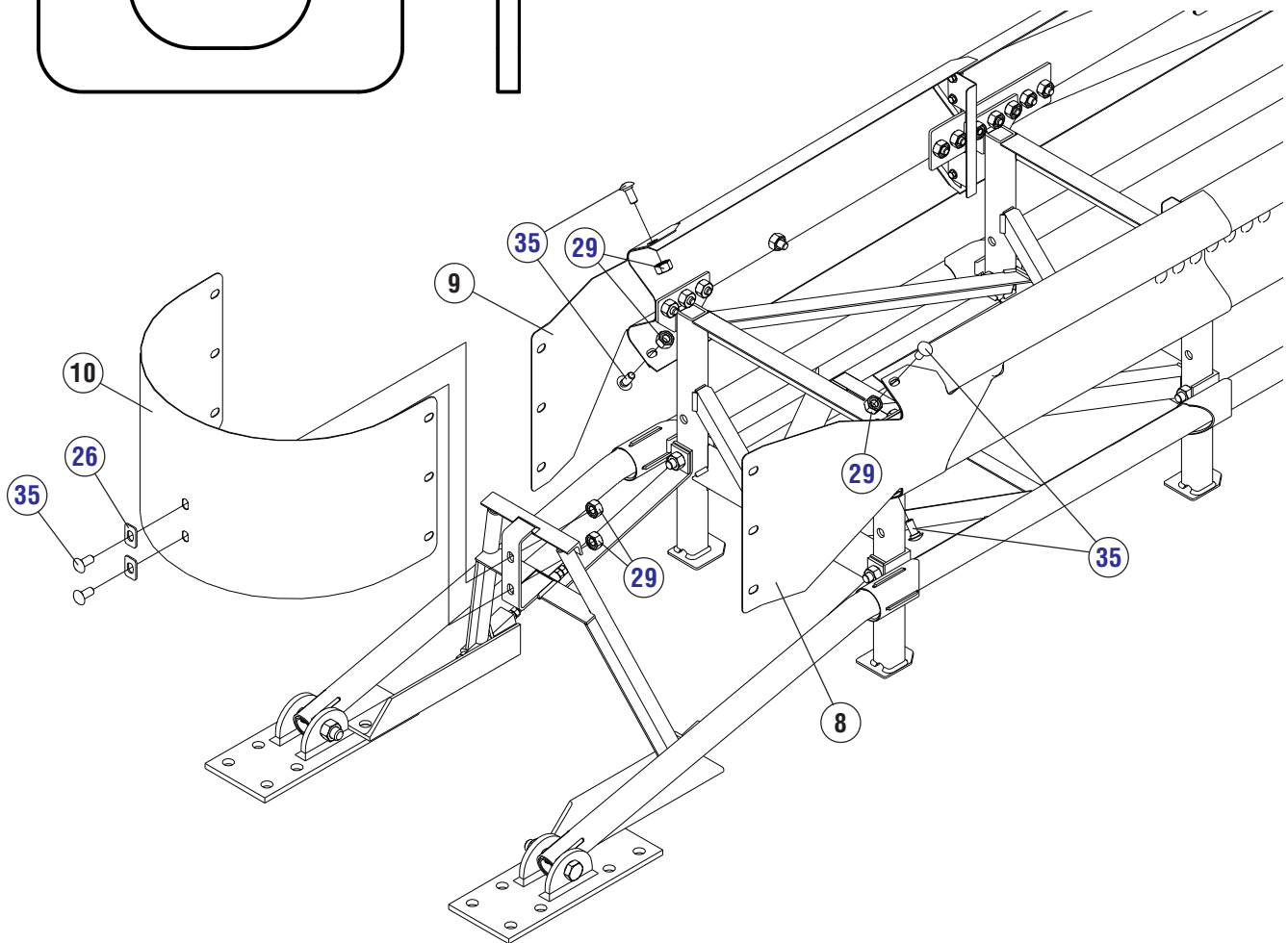
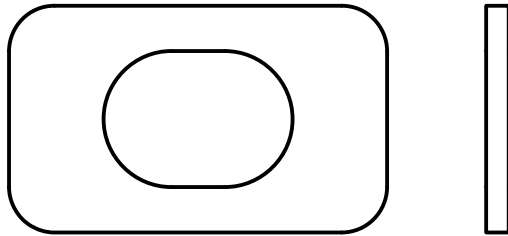
③⑤ 2699062-0000 BOLT,RAIL,M16X2X35,G (6)



②⑨ 2704923-0000 NUT,HX,M16X2,RAIL,G (6)



②⑥ 2708051-1000 WASHER,BAR,50X30X6,ROUNDED,G (2)

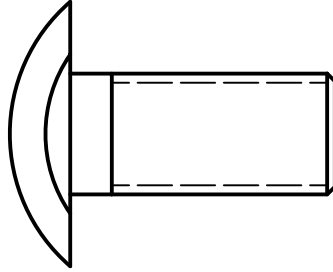
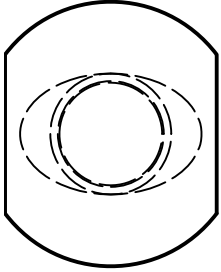


QUEST® DCM System

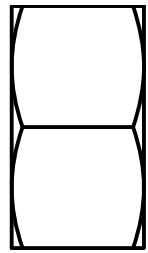
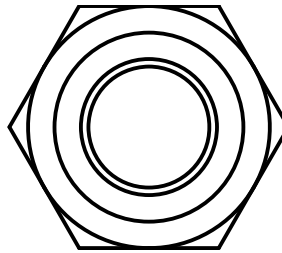
Assembly (cont'd.)

Step 14C

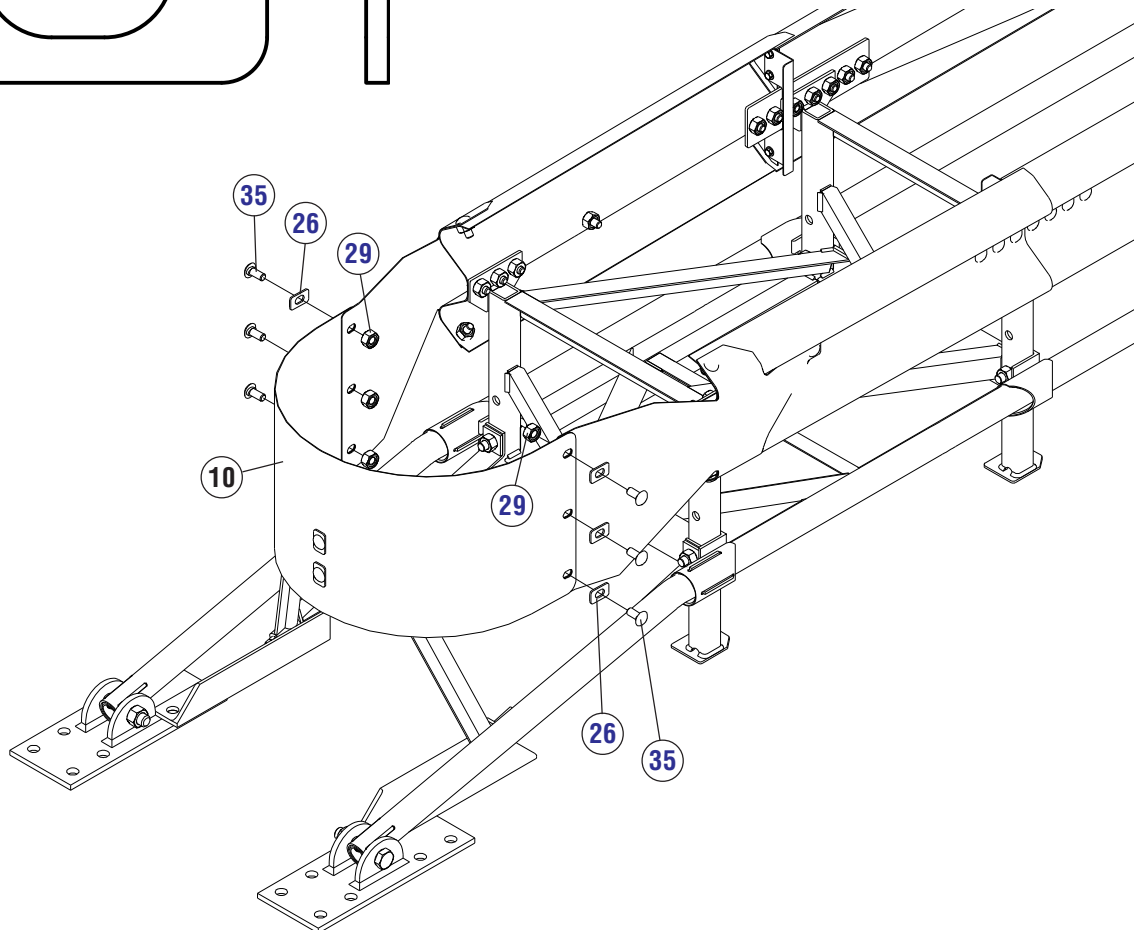
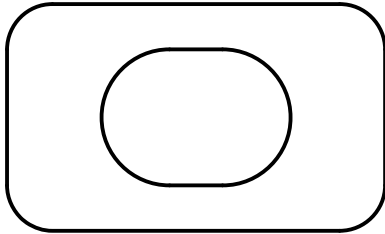
③⑤ 2699062-0000 BOLT,RAIL,M16X2X35,G (6)



②⑨ 2704923-0000 NUT,HX,M16X2,RAIL,G (6)



②⑥ 2708051-1000 WASHER,BAR,50X30X6,ROUNDED,G (6)



QUEST[®] DCM System

Installation

Required Tools

Documentation

- Manufacturer's Installation Manual
- Manufacturer's Drawing Package

Cutting equipment

- Rebar Cutting Bit - 22 mm
- Concrete Drill Bits - 22 mm (*Two Fluted)
- Grinder, Hacksaw or Torch (optional)

* Valtir recommends using two fluted drills to achieve optimum tensile strength when installing the MP-3 anchoring system.

Hammers

- Roto Hammer Drill
- Sledgehammer
- Standard Hammer

Wrenches

- Heavy Duty Impact Wrench - 1/2" Drive
- Standard adjustable wrench - 300 mm
- 1/2" drive sockets: 1 1/8", 1 1/4", 1 1/2"
- Deep Sockets: 1 1/4"
- Ratchet and attachments for the above sockets
- Breaker Bar: 1/2" x 24"
- Torque Wrench: 200 ft-lbs.
- 2 ea. Open/Box End Wrench - 3/4"

Personal protective equipment

- Safety Glasses
- Gloves

Miscellaneous

- Traffic Control Equipment
- Lifting and Moving Equipment (A lifting device is preferred although a forklift can be used.) Minimum 5,000 lb. capacity required.
- Compressor (100 psi) and Generator (5 KW)
- Long Pry Bar
- Drift Pin 300 mm
- Center Punch
- Tape Measure 7.5 m
- Chalk Line
- Concrete Marking Pencil
- Nylon bottle brush for cleaning 7/8" drilled holes
- Rags, Water, and Solvent for Touch-up

Note: The above list of tools is a general recommendation. The actual number of tools required will depend on specific site conditions and the complexity of the installation.

QUEST® DCM System

Installation (cont'd.)

Site Preparation/Foundation

Concrete Installations

For concrete installations, the QUEST DCM System should be installed only on an existing or freshly placed and cured concrete base (28 MPa minimum). Use 178 mm threaded rods, installed with the two part MP-3 grout (refer to Figure 3). Location and orientation of the concrete base and attenuator must comply with project plans or as otherwise determined by the resident project engineer.

For an independent, soil-supported concrete foundation, include a below-grade anchor block as part of the pad. The large block will keep the pad from sliding during an impact. Additional details can be found on the standard drawings and project plans.

CAUTION: Accurate placement of all steel rebar is critical to avoid interference with the concrete anchor bolts.

Asphalt Installations

The QUEST DCM System may be installed on asphalt or asphalt overlays. Provide a minimum of 76 mm layer of asphalt over a minimum of 76 mm layer of Portland Cement concrete, 152 mm layer of asphalt over 152 mm layer of subbase, or 203 mm layer of asphalt with no subbase. Refer to Figures 4, 5 or 6. Use 460 mm threaded rods, installed with the two part MP-3 grout for these foundations.

Cross Slope

Installation cross slope should not exceed 8% (see Figure 2) and should not vary more than 2% over the length of the system; the pad surface should have a light broom finish.

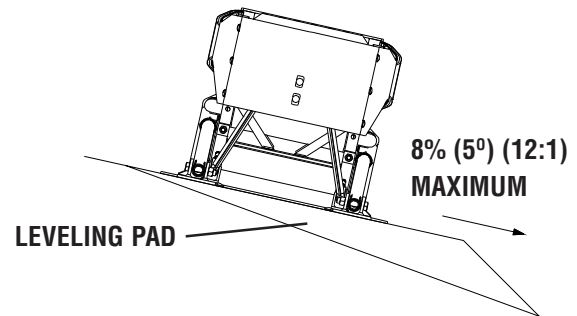


Figure 2
Cross-Slope

WARNING!

Location of the backup in relation to the hazard and nearby objects will affect the operation of the attenuator. Upon impact, the shaper rails stroke toward and extend beyond the rigid backup and hazard as much as 1.5 m from their pre-impact location, therefore the backup must nest around concrete walls, barriers and pillars. Failure to comply with this requirement may result in impaired system performance offering motorists less protection.

QUEST[®] DCM System

Installation (cont'd.)

The QUEST DCM System may be installed on any of the following foundations using the specified anchorage:

A: Concrete Pad

Foundation

150 mm minimum, reinforced
Portland Cement Concrete (P.C.C.)

Anchorage

MP-3 Polyester Anchoring System:

- 178 mm studs
- 140 mm embedment

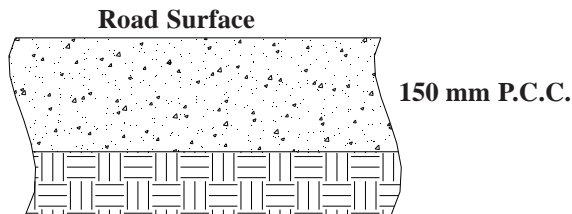


Figure 3
Concrete Pad

B: Asphalt over P.C.C.

Foundation

75 mm minimum Asphaltic Concrete (A.C.) over
75 mm minimum Portland Cement Concrete (P.C.C.)

Anchorage

MP-3 Polyester Anchoring System:

- 460 mm studs
- 420 mm embedment

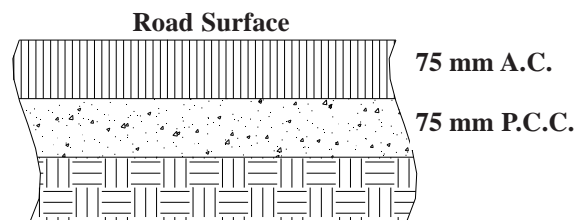
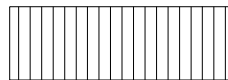


Figure 4
Asphalt/Concrete

Definitions:

A. C. (Asphaltic Concrete)



AR-4000 A. C. (Per ASTM D3381 '83) .75" Maximum,
Medium (Type A or B) aggregate.

Sieve Size	Operating Range (%) Passing
1"	100
3/4"	95-100
3/8"	65-80
No. 4	49-54
No. 8	36-40
No. 30	18-21
No. 200	3-8

QUEST® DCM System

Installation (cont'd.)

Foundation

150 mm minimum Asphaltic Concrete (A.C.) over
150 mm minimum Compacted Subbase (C.S.)

Anchorage

MP-3 Polyester Anchoring System:

- 460 mm studs
- 420 mm embedment

D: Asphalt Only

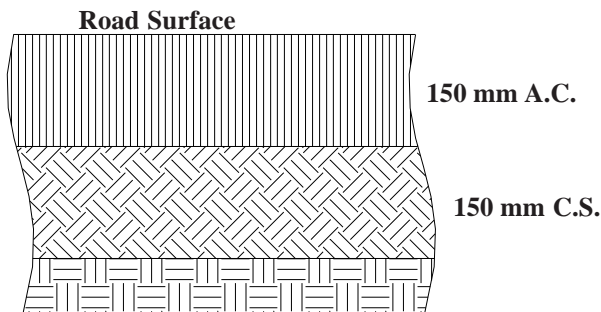


Figure 5
Asphalt/Subbase

Foundation

200 mm minimum (A.C.).

Anchorage

MP-3 Polyester Anchoring System:

- 460 mm studs
- 420 mm embedment

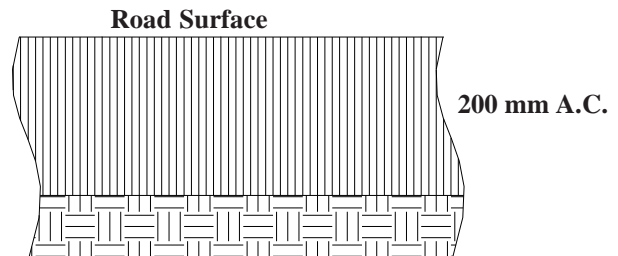
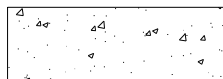


Figure 6
Asphalt

P.C.C.

(Portland Cement Concrete)



Stone aggregate concrete mix, 28 MPa minimum 28 day compressive strength (Sampling per ASTM C31-84 or ASTM C42-84a, testing per ASTM C39-84).

C.S. (Compacted Subbase)



150 mm minimum depth 95% compaction, Class 2 aggregate.

Sieve Size	Moving Average (%) Passing
3"	100
2 1/2"	90-100
No. 4	40-90
No. 200	0-25

QUEST® DCM System

Installation (cont'd.)

Installation Procedures

Note: The drawing package provided with the QUEST DCM System must be used with these instructions for proper assembly and should take precedence over these general instructions.

1) Deploy Traffic Control

A traffic control plan appropriate to the complexity of the project should be prepared and understood by all parties before the QUEST DCM System is installed.

Deploy the appropriate work zone safety devices prior to beginning the installation and keep them present through all phases on the installation.

2) Determining the Basepoint & Centerline

Typically the basepoint of the QUEST DCM System will be the midpoint of the hazard at its front face.

WARNING!

The backup is designed to nest around concrete walls, barriers and pillars 610 mm in width or less. Failure to nest the backup around these types of hazards may result in impaired system performance.

Extend a chalk line from the basepoint, perpendicular to the hazard face, or as determined by project engineer, to a distance greater than the maximum length of the QUEST DCM System (refer to the drawings provided). This chalk line will become the centerline for the QUEST DCM System. See Figure 7.

Note that the QUEST DCM System, when properly installed, appears to be an extension of the object which it is shielding. See Figure 8.

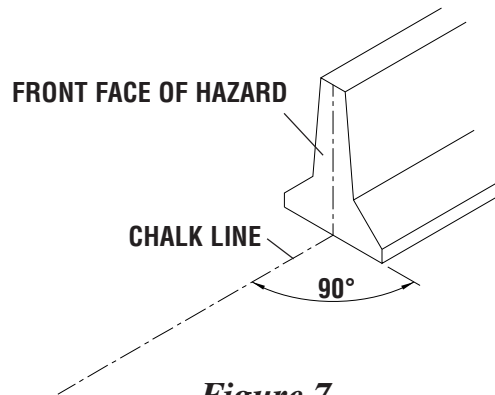


Figure 7
QUEST DCM System Placement

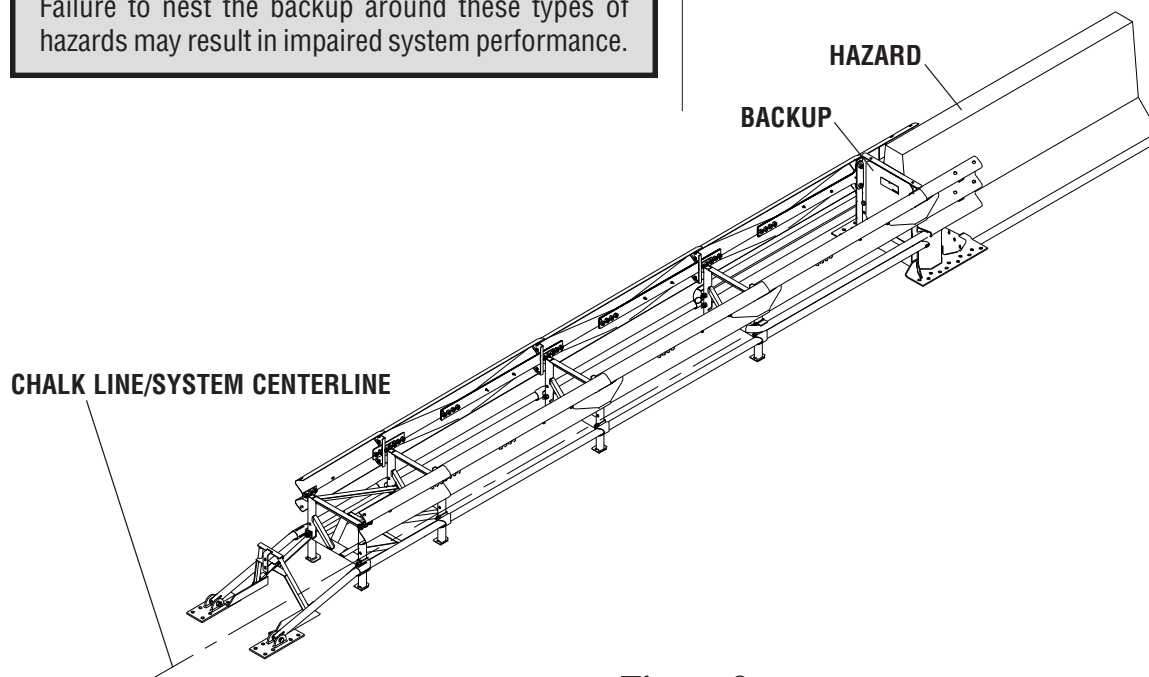


Figure 8
Backup Location

QUEST® DCM System

Installation (cont'd.)

3) Lifting/Placing the System

Use the lifting points to lift the QUEST DCM System into place. See Figure 9.

DO NOT LIFT SYSTEM USING THE TUBE RAILS!

Use fixed-length slings with a 1365 kg [3,000 lb.] minimum capacity. Fixed slings will prevent system tipping. Do not lift over head.

For installations shielding concrete wall, safety shape barrier or pillar, the steel backup should be nested around the hazard (see Figure 8).

WARNING!

Lift only fully assembled systems.

4) Adjusting the Shaper Rails

Adjust the shaper rails and front anchors as necessary to properly align the system.

5) Drill and Set Anchors

Use the holes in the Backup and Front Anchor Plates as a template to locate and drill holes.

For Concrete Installations

The Backup requires 18 MP-3 anchors, 9 anchors on the left side and 9 anchors on the right side. Additional holes are provided in the event that rebar is encountered when drilling.

The front anchor assemblies require 12 MP-3 anchors, 6 in each anchor plate. Additional holes are provided in the event that rebar is encountered when drilling.

Drill 22 mm diameter x 140 mm deep holes into the concrete pad or roadway (see Figure 31). Use vertical MP-3 kits to install 3/4" diameter x 7" long studs using instructions included with kit. After grout is hardened, use 3/4" flat washers and nuts provided with kit to anchor system to foundation.

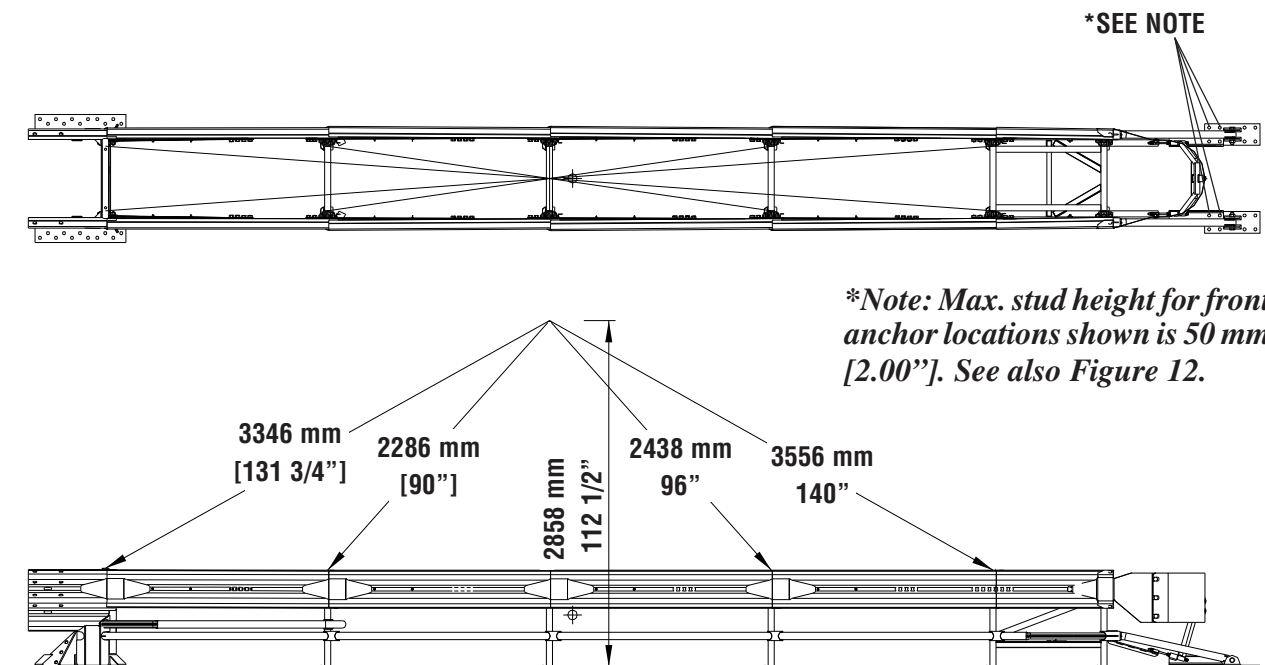


Figure 9
Lifting locations

QUEST® DCM System

Installation (cont'd.)

For Asphalt Installations

Every anchor hole in the backup and front anchor assemblies must have an MP-3 stud anchoring it.

Drill 22 mm diameter x 420 mm deep holes into the asphalt roadway. Use vertical MP-3 kits to install 3/4" diameter x 18" long studs using instructions included with kit. After grout is hardened, use 3/4" flat washers and nuts provided with kit to anchor system to foundation.

6) Adjusting the Trigger Assembly

Tension threaded rod by tightening upper nut an 1/8 to 1/4 turn past snug. Install second nut on upper side and jam (typical both sides). See Figure 10. See also procedure outlined in the drawing package.

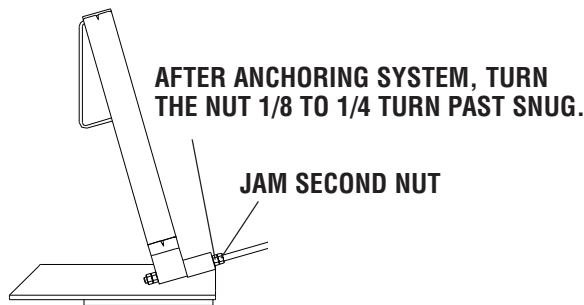


Figure 10
Trigger Assembly Adjustment

7) Tension Shaper Rails

Tighten large bolts in the rear of the shaper rail assembly (see Figure 11). See warning below.

WARNING!

Once the grout has hardened (refer to table B on page 43 for hardening times),

- 3/4" x 7" Anchor Studs ...Torque to 165 Nm
Should not protrude above threads (See Figure 22)
- 3/4" x 18" Anchor Studs ..Torque to <15 Nm
(See Figure 25)
- Trigger AssemblyTighten
- Large BoltTighten

Note: For ease of installation, nose assembly should be left off until system is anchored. See Steps 17, 18 & 19 on pages 31, 32 & 33 for attaching nose assembly.

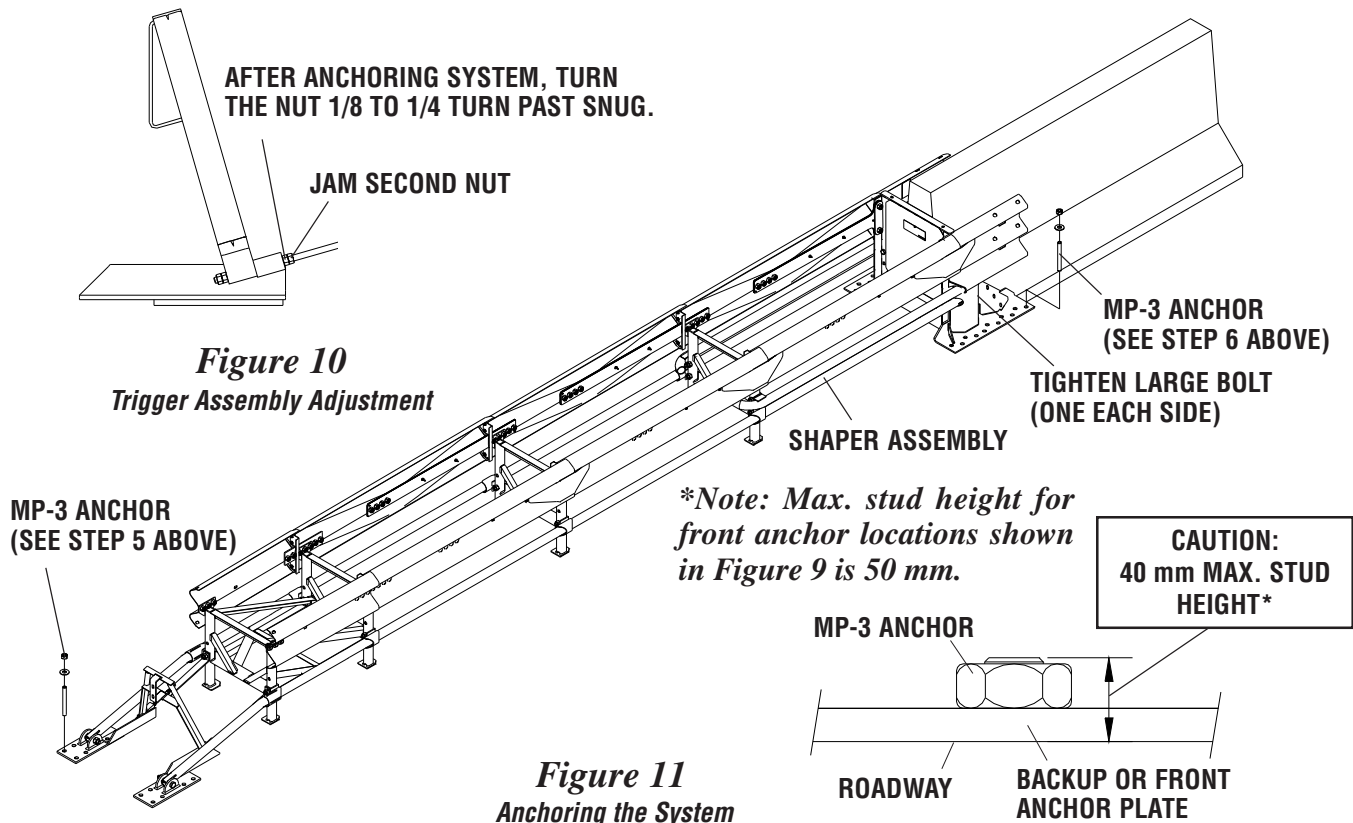


Figure 11
Anchoring the System

Figure 12
Proper Stud Height

QUEST® DCM System

Installation (cont'd.)

Optional DPA Anchorage

The QUEST DCM System is also available with a Drivable Pile Anchor (DPA) Anchorage option allowing the system to be installed in strong soil conditions. The following installation steps are to be used in combination with the steps previously outlined for permanent installations.

A) *Attach Wing Plates to Front Anchors and Backup*

Lift and hold the QUEST DCM System with a fork lift. Place the forks under the Bay 2 Fender Panels and carefully lift the system and hold in a safe position.

Using 3/4" hex bolts, washers and nuts, attach the front wing plate to the front anchors and the rear wing plate to the backup. See Figure 13.

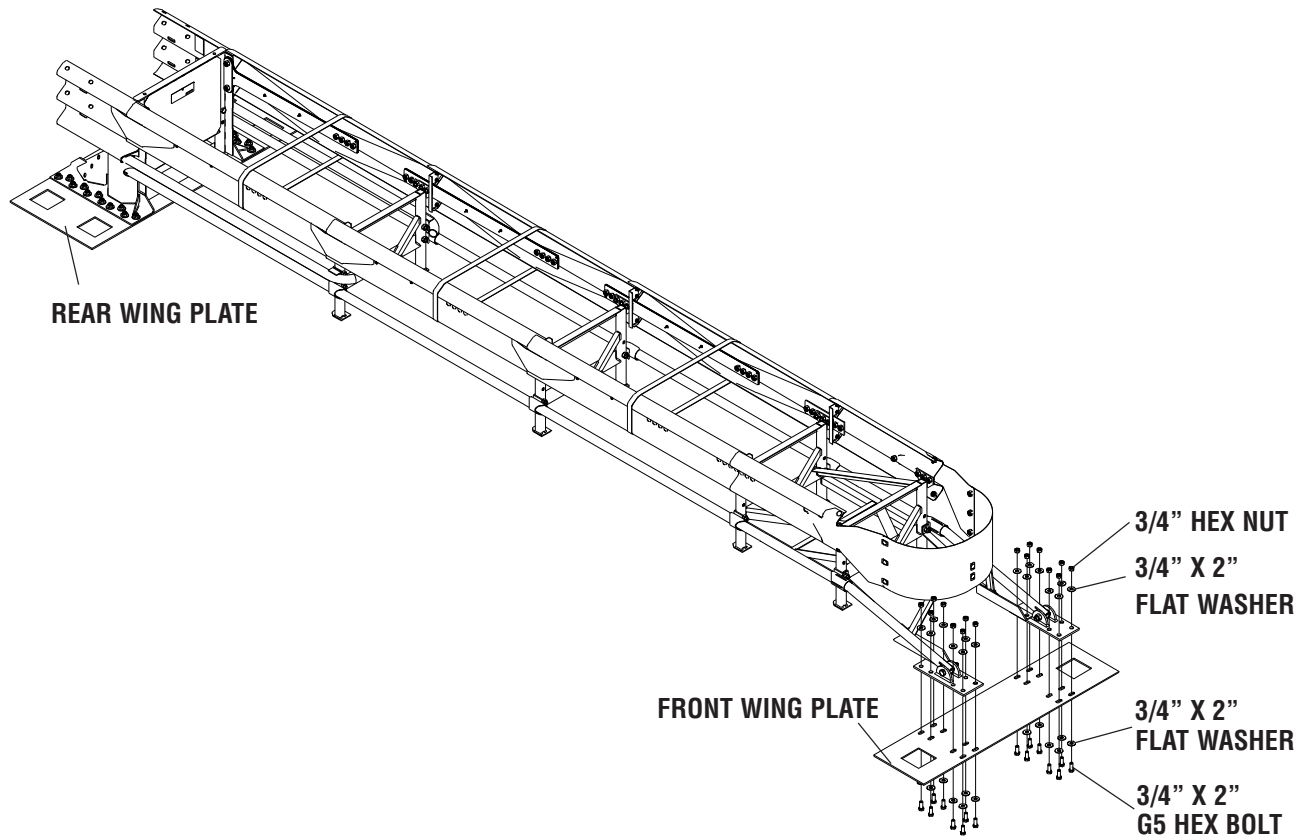


Figure 13
Wing Plate Attachment

QUEST® DCM System

Installation (cont'd.)

Optional DPA Anchorage (cont'd.)

B) Determine the Basepoint and Centerline

Typically the basepoint of the QUEST DCM System will be the midpoint of the hazard at its front face.

Extend a chalk line from the basepoint, perpendicular to the hazard face, or as determined by project engineer, to a distance greater than the maximum length of the QUEST DCM System (refer to the drawings provided).

This chalk line will become the centerline for the QUEST DCM System. See Figure 14.

Note that the QUEST DCM System, when properly installed, appears to be an extension of the object which it is shielding. See Figure 14.

WARNING!

Location of the system with respect to the hazard is critical and dependent on the type of transition panel used. See the project plans supplied with the System for details.

C) Anchor the System

Note: The system is not to be used on cross slopes that exceed 8% or vary (twist) more than 2% from front to back. For these conditions, a leveling pad or grading is required. See Figure 16.

Use the parts supplied by Valtir, LLC.

QUEST DCM Systems installed on asphalt or soil must be inspected to ensure the system is properly anchored following each impact. Refurbish and re-anchor as necessary.

1. Lift the system into place at the marked location. If required, attach the system to the hazard/ barrier via transition panel(s), see Figure 15.

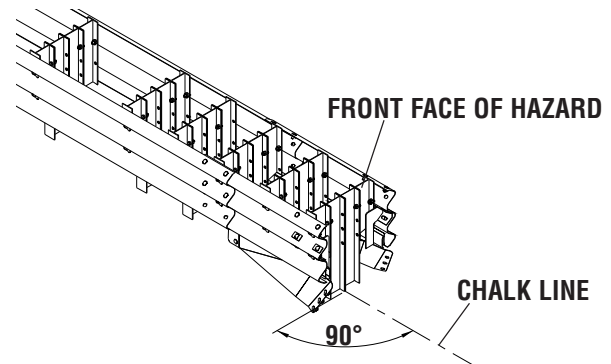


Figure 14
Backup Location

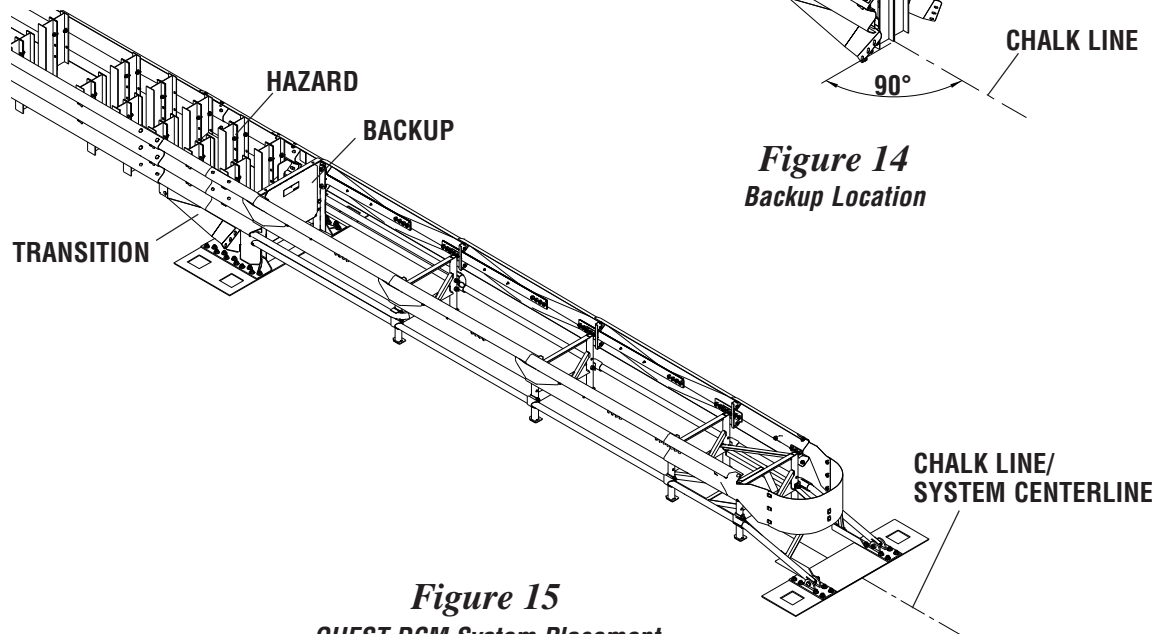


Figure 15
QUEST DCM System Placement

QUEST® DCM System

Optional DPA Anchorage (cont'd.)

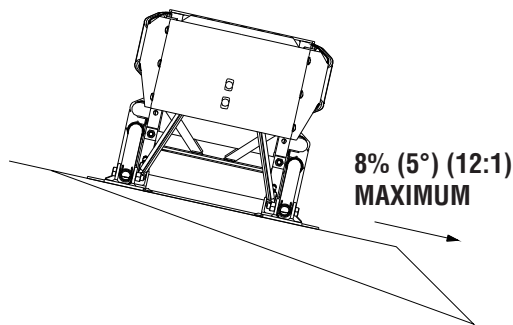


Figure 16
Max. Allowable Cross Slope

2. Once system is in place, position pile driving equipment over a square hole in the outboard wing plate as shown in Figure 17.
3. Place the 72 3/4"x6"x6" Drivable Post into the square hole in the wing plate as shown in Figure 17. Use a small level to ensure the post is straight for pile driving. Drive post into the ground until the post's top plate is flush with the top of the wing plate.

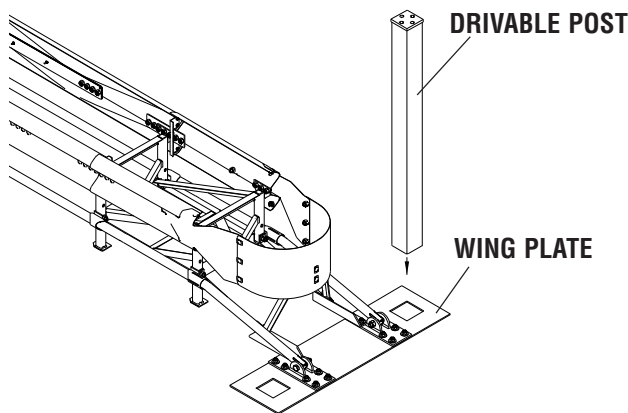


Figure 17

4. Use the 3/4"x2 1/2" hex bolts to fasten the 3/4"x10"x10" Post Cap to the top of the post as shown in Figure 18.

Note: Walk-up inspections are recommended at least once every six months.

D) Moving the System

Unfasten all post caps, inspect for damage and set aside for next installation. Replace all damaged parts. Free the system from anchor posts. To accomplish

this, start at the nose of the system and use pry bars to gradually raise the system off the posts. Place blocks under the monorail plates and work down the length of the system until the system is completely free. Follow the lifting procedures outlined in this Manual to lift and place the System into its new location.

E) Extracting Drivable Pile Anchors

Fasten a 3/4" threaded lifting ring or eye into a hole at the top of the post. Attach a hoist or crane to the ring and pull the post from the ground. Remove posts as necessary and backfill holes created by the extraction.

WARNING!

The posts will be filled with soil and extremely heavy. Handle with caution.

F) DPA Refurbishment

Remove all soil and other material from inside of the post being careful not to damage the side walls of the tubing. The bottoms of the posts may be damaged from initial pile driving. Cut the damaged portion of tubing from the post so that side walls are straight for the next installation. If the side walls of the post are damaged at more than 305mm from the bottom of the post, scrap the post and replace it with a new one.

Reinstall system per instructions A through C.

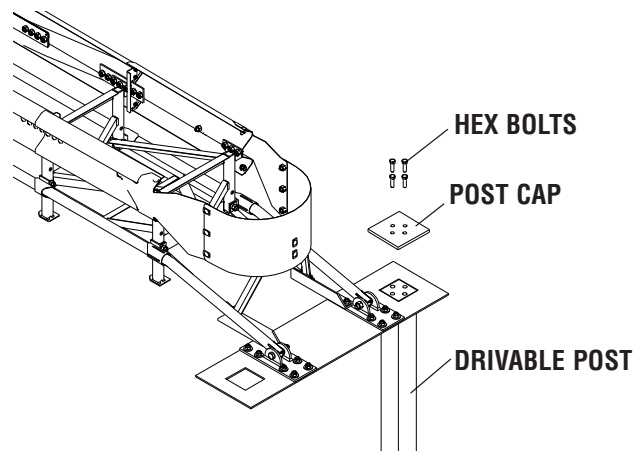


Figure 18

Repeat this procedure until system is completely anchored.

QUEST® DCM System

Installation (cont'd.)

Bidirectional Traffic

If a QUEST DCM System is placed in a location where traffic will be approaching from the rear, a transition from the object being shielded to the backup may be required. Hardware is available to mount guardrail or a safety shaped barrier to the steel backup of the QUEST DCM System.

WARNING!

Location of the system with respect to hazard is critical and dependent on the type of transition panel used. See project plans supplied with the system for details.

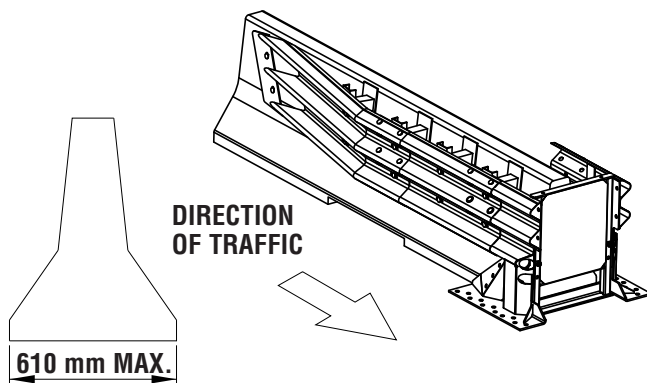


Figure 19
Thrie-Beam to Safety Barrier Transition Panel

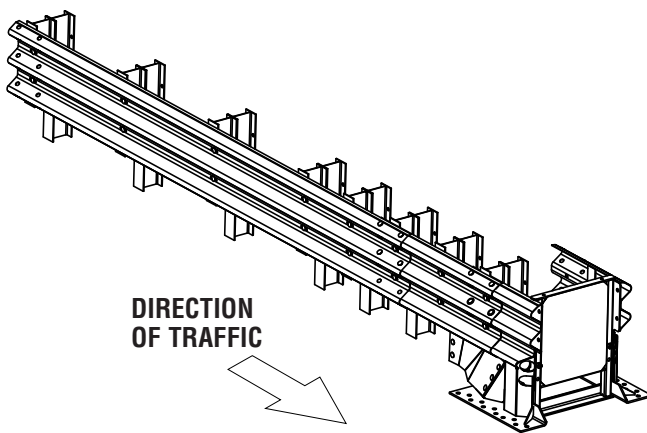


Figure 21
Transition to Thrie-Beam Guardrail

Transition and Side Panel Types

Note: The proper transition or side panel must be used for optimum impact performance of the system. The correct panel to use will depend on the direction of traffic and what type of barrier or hazard the QUEST DCM System is shielding. Contact Customer Service Department at +44 (0) 1473 221105 prior to installation if you have any QUESTions.

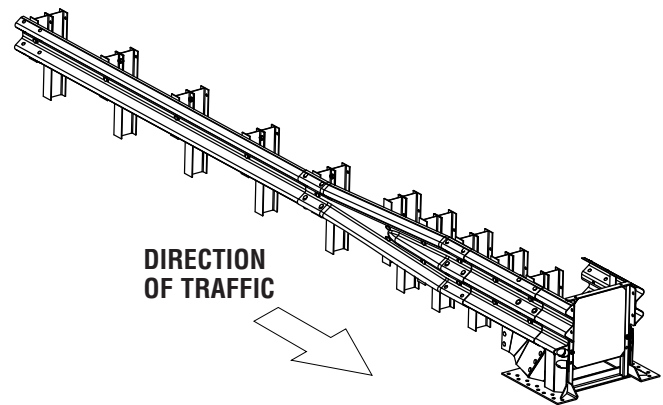


Figure 20
Thrie-Beam to W Transition Panel

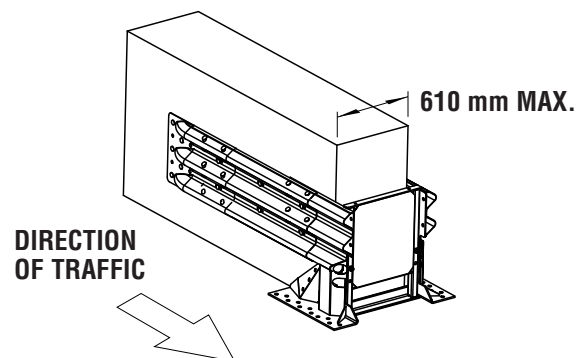


Figure 22
Thrie-Beam End Shoe Transition Panel

QUEST® DCM System

MP-3® Polyester Anchoring System

The MP-3 Polyester Anchoring System is a quick and easy way to securely anchor crash cushions and other common highway devices. MP-3 features high pullout strength, superior vibration resistance, and exceptional durability.

Each MP-3 kit contains a can of MP-3 resin, hardener, cold weather promoter, studs, washers, and a complete safety sheet. The cold weather promoter shortens hardening time by as much as seven hours. Both vertical and horizontal installations are possible using the MP-3 System.

Vertical Installations

Note: Read MP-3 Instructions before starting.

WARNING!

Do not allow the MP-3 Resin or Hardener to contact skin or eyes. See material safety data sheet supplied with the MP-3 kit for first-aid procedures. Use only in well-ventilated area. Do not use near open flame.

WARNING!

Wear safety goggles and gloves during installation.

1) Prepare the concrete pad

The anchor bolts (Studs) that anchor the QUEST DCM System to the concrete pad must be those shipped in the kit or of high strength steel (830 MPa minimum tensile strength or equal). These studs must be set in minimum 28 MPa concrete. Allow the concrete to cure a minimum of 7 days before installing MP-3.

2) Drill holes

Note: Valtir recommends using two fluted drill bits to achieve optimum ten-sile strength when installing the MP-3 anchoring system.

Use the part that is to be anchored as a drilling template. Drill the holes 3 mm larger than the stud diameter to the recommended depth, using a rotary percussive drill. Full strength will not be achieved if a diamond drill is used. Refer to the MP-3 installation instructions provided with your kit. Check to be sure all the holes are drilled to the proper depth and aligned with the part to be anchored. Refer to Table A.

Table A: MP-3 Anchoring Information

3/4" Ø Stud length	Concrete bit size	Minimum Depth	Recommended Torque
6 1/2"	22 mm [7/8"]	125 mm [5"]	165 Nm [120 ft-lbs]
7"			
7 1/2"	22 mm [7/8"]	140 mm [5 1/2"]	165 Nm [120 ft-lbs]
8 1/2"			
18"	22 mm [7/8"]	420 mm [16 1/2"]	<15 Nm [<10 ft-lbs]

3) Clean the holes

Blow the concrete dust from the hole, using oil-free compressed air. Thoroughly brush it with a stiff-bristled brush, and then blow it out again. If the hole is wet, completely flush it with water while brushing, then blow it clean, using oil-free compressed air.

4) Mix the resin and hardener

Wearing gloves and safety goggles, remove the lids from the MP-3 Part A-Resin and Part B-Hardener containers. Pour Part B into Part A, then mix vigorously for 30 seconds to form MP-3 grout (an anchor stud may serve as a stirring rod).

5) Add cold weather promoter (in cold weather)

For faster hardening in cold weather, Promoter may be used. Add the entire contents of the partially filled Promoter container to the MP-3 grout; then mix for an additional 30 seconds. Use immediately because the MP-3 grout will thicken quickly. Refer to Table B for hardening times.

6) Pour grout into holes

WARNING!

Do not use Promoter when the temperature is above 15 degrees Celsius (60 degrees Fahrenheit). Grout will harden too quickly.

QUEST® DCM System

MP-3® Polyester Anchoring System (cont'd.)

Crimp the mouth of the can to form a spout, and pour the MP-3® grout mixture down into the hole through the part. Fill the hole 1/3 to 1/2 full.

CAUTION: Do not overfill or underfill the hole. If the hole is overfilled, there will not be enough grout to use all of the anchor studs/kit. If hole is underfilled the grout may not develop the required pull out strength.

7) Add the washers and nuts

Place a flat washer onto the stud; then thread a nut on until **1 or 2 threads of the NUT** are left exposed.

8) Insert Studs in holes and wait for grout to harden

Push the stud down through the part to be anchored and into the hole. Give the stud several twists in the MP-3 to wet the threads.

CAUTION: Do not disturb or load the stud until the MP-3 material has hardened (see Table B).

9) Torque the nuts

Once the grout has hardened, torque the nut to the recommended values. (See Table A.)

Table B: Approximate Hardening Times (hrs)

Temperature (C)	Temperature (F)	No Promoter	With Promoter
>26	>80	1/2	N/R*
22-26	70-79	1	N/R*
16-21	60-69	2	N/R*
10-15	50-59	4	3/4
4-9	40-49	8	1
-1-3	30-39	N/R*	1 1/2
<-1	<30	N/R*	N/R*

* Not recommended. Contact Valtir's Customer Service Department for more information.

Horizontal Installations

The horizontal MP-3 kit is the same as the vertical kit except that a cartridge for a standard caulking gun is supplied in the horizontal kits and the resin for the horizontal kits is a thixotropic (TX) resin. The TX-Resin is a gelled resin designed to keep the grout in place in horizontal holes during installation.

When using the horizontal MP-3 kits follow the vertical instructions with the following exceptions:

1) Thread dispensing tip onto dispenser

Prior to mixing the grout, carefully thread the dispensing tip onto the dispenser.

2) Pour mixed grout into dispenser

Once the grout is mixed crimp the mouth of the can to form a spout, and pour the MP-3 grout into the open end of the dispenser (use mixing stud to scrape out the portion remaining in the can). You may use the box to hold the dispenser upright. Close the box lid and poke the dispenser tip into the top of it. Seal the dispenser with the plunger provided.

3) Place dispenser in caulking gun and dispense grout

Cut off the small end of the dispenser tip. Place the dispenser into a caulking gun and dispense until MP-3 TX grout reaches the tip of the dispenser, then release pressure. Push the dispenser tip through the part to the bottom of the hole and dispense while slowly withdrawing the tip.

CAUTION: Do not overfill or underfill the hole. Fill hole approximately 1/3 to 1/2 full. If the hole is overfilled, there will not be enough grout to use all of the anchor studs/kit. If hole is underfilled the grout may not develop the required pull out strength.

QUEST® DCM System

MP-3® Polyester Anchoring System (cont'd.)

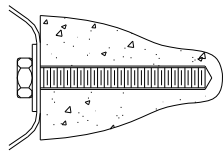
4) Add the washers and nuts

Put washer and nut on stud leaving nut flush with end of stud. See Figure 23.

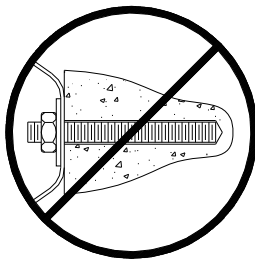
5) Insert Studs into holes

Push stud through part to be anchored and into hole.

Note: In Horizontal Applications the stud should be flush with the top of the nut. Torque to 165 Nm.



CORRECT



INCORRECT

Figure 23
MP-3 Horizontal Installation

MP-3 Installation Cautions

1) Shelf life

If the shelf life of the MP-3® has expired (see MP-3 kit for expiration information), mix a small amount of MP-3 in the proportions of one part A to two parts B by volume. If the material does not set according to the instructions, contact Valtir, LLC. for guidance.

WARNING!

Do not use the MP-3 if: the material fails to set up, Part A-Resin has gelled (for vertical applications), or TX-Resin is NOT gelled (for horizontal applications).

2) Steel rebar

If steel rebar is encountered while drilling an MP-3 anchor bolt hole, apply one of the following solutions:

A. Using a diamond core drill or rebar drilling tool, drill through the rebar only, then switch back to the concrete bit and drill into the underlying concrete until the proper hole depth is reached.

CAUTION: Do not drill through rebar without first obtaining permission to do so from the local project engineer.

B. Drill a new hole down at an angle past the rebar to the proper depth. Anchor the stud by completely filling both holes with MP-3.

QUEST® DCM System

Maintenance Checklist

How often Maintenance is required will depend upon site conditions. Visual drive-by inspections are recommended at least once a month. Walk-up inspections are recommended at least once a year for installations on concrete and at least once every six months for installations on asphalt.

Visual Drive-by Inspection

- 1) Check to see if there is any evidence of an impact (deformed nose or side panels). If so, a walk-up inspection will be necessary.
- 2) Check to see that the surface under the system is clear of debris to ensure proper performance.
- 3) Note the location, condition of the QUEST DCM System and the date of the visual drive-by inspection. Drive-by inspections are recommended on an as needed basis based upon traffic volume, site accident history, etc.

Walk-Up Inspection

- 1) Clear and dispose of any debris on the site.
- 2) Be sure all bolts are tight and rust-free.
- 3) Be sure anchor bolts are securely anchored.
- 4) Be sure the tube rails are tensioned and rust-free.
- 5) Check to see that the trigger bolts in the front anchor assembly are intact.
- 6) Check to see that the support frame assembly has not engaged the shaper rails. Both shapers must be over the forward-most part of the pre-crimped portion of the shaper rails.
- 7) Check to see that the laminate straps at the fender panels are intact and connection points are installed correctly.
- 8) Check to make sure that the diaphragm legs are on grade level and clear of debris.
- 9) Note the location and condition of the QUEST DCM System for entry in the impact attenuator inspection logbook under the date of this inspection. Walk-up inspections are recommended on an as needed basis based upon traffic volume, site accident history, etc.
- 10) Refer to Post-Impact Instructions for more information.

QUEST® DCM System

Post-Impact Instructions

General Maintenance Information

Due to its light weight, short length and minimal number of anchors, the QUEST DCM System is designed for field repair or rapid replacement of the entire unit.

Depending upon the severity of the impact and site conditions, the QUEST DCM System can be either refurbished on the roadside or repaired in the maintenance shop away from traffic dangers.

Some of the QUEST DCM System's components remain undamaged after less severe impacts making refurbishment possible. Entire units can be repaired and then reused on the roadside or the damaged portion can be refurbished and reused as needed.

IMPORTANT: After an impact, always follow the "Post-Impact Instructions" in the maintenance section of the Installation Manual.

Required Tools

Documentation

- Manufacturer's Installation Manual
- Manufacturer's Drawing Package

Cutting equipment

- Rebar Cutting Bit - 22 mm
- Concrete Drill Bits - 22 mm
- Grinder, Hacksaw or Torch (optional)

Hammers

- Roto Hammer Drill
- Sledgehammer
- Standard Hammer

Wrenches

- Heavy Duty Impact Wrench - 1/2" Drive
- Standard adjustable wrench - 300 mm
- 1/2" drive sockets: 1 1/8", 1 1/4", 1 1/2"
- Deep Sockets: 1 1/4"
- Ratchet and attachments for the above sockets
- Breaker Bar: 1/2" x 24"
- Torque Wrench: 200 ft-lbs.
- 2 ea. Open/Box End Wrench - 3/4"

Personal protective equipment

- Safety Glasses
- Gloves

Miscellaneous

- Traffic Control Equipment
- Lifting and Moving Equipment (A lifting device is preferred although a forklift can be used.) Minimum 2300 kg capacity required.
- Compressor (100 psi) and Generator (5 KW)
- Long Pry Bar
- Drift Pin 300 mm
- Center Punch
- Tape Measure 7.5 m
- Chalk Line
- Concrete Marking Pencil
- Nylon bottle brush for cleaning 7/8" drilled holes
- Rags, Water, and Solvent for Touch-up

Note: The above list of tools is a general recommendation. The actual number of tools required will depend on specific site conditions and the complexity of the installation.

QUEST[®] DCM System

Post-Impact Instructions (cont'd.)

Procedure

- 1) Deploy the appropriate traffic-control devices to protect your crew.
- 2) Clear and dispose of any debris on the site.
- 3) Check all components of the QUEST DCM System; any components that are bent or damaged must be replaced. After a design speed impact on the nose, it is possible that the only parts that will be reusable are the backup and front anchor assemblies.
- 4) To refurbish the QUEST DCM System, disassemble the system and replace the damaged parts with new parts.
- 5) The shaper rail assemblies must be replaced if the support frame has begun to crimp the pipes.
- 6) During the process of refurbishment, follow the installation drawings and instructions.
- 7) Check to be certain that the site is free from any debris. The QUEST DCM System is now ready for service.

Parts Ordering Procedure

- 1) Make a list of all damaged parts using the part descriptions and part numbers shown on the installation drawings.
- 2) Contact the Valtir's Customer Service Department at 1 (214) 589-8140 for orders and for answer to any QUESTions.

QUEST® DCM System

Limitations and Warnings

The QUEST DCM System has been tested and evaluated in accordance with European Standard EN 1317:2000. The impact conditions tested are intended to represent a wide range of in-service impact conditions, but do not encompass all possible in-service impact conditions.

The following full-scale crash tests have been conducted on the QUEST DCM System, and in each test all evaluation criteria specified in European Standard EN 1317:2000 were met. Properly installed and maintained, the QUEST DCM System is capable of performing its functions of stopping or containing and redirecting impacting vehicles in accordance with European Standard EN 1317:2000 for the impact conditions listed in Table A.

Table A -- SUMMARY OF QUEST CEN EN 1317 TESTS				
Performance Level	EN 1317 Test No.	Vehicle Mass (kg)	Impact speed (km/h)	Impact Angle & Impact Point
110	Parent model at minimum taper/width - TD110CEN610			
	TC 1.1.100	900	100	0 deg, head-on, centre
	TC 1.3.110	1500	110	0 deg, head-on, centre
	TC 2.1.100	900	100	0 deg, 1/4 vehicle offset
	TC 3.3.110	1500	110	15 deg, nose (centre)
	TC 4.3.110	1500	110	15 deg, redirect at L/3
	TC 5.3.110	1500	110	165 deg, redirect at L/2
	Maximum taper/width model - TD110CEN610			
	TC 1.1.100	900	100	0 deg, head-on, centre
	TC 4.3.110	1500	110	15 deg, redirect at L/3
100	Minimum taper/width model - TD100CEN610			
	TC 1.2.100	1300	100	0 deg, head-on, centre
	Maximum taper/width model - TD100CEN610			
TC 4.2.100	1300	100	15 deg, redirect at L/3	
80	Minimum taper/width model - TD80CEN610			
	TC 1.2.80	1300	80	0 deg, head-on, centre
	Maximum taper/width model - TD80CEN610			
TC 4.2.80	1300	80	15 deg, redirect at L/3	

Impact conditions which differ from those described in European Standard EN 1317:2000 may yield results different from those encountered in testing. In particular, impact conditions in excess of specified impact severity, or existence at the site of curbs or cross slopes in excess of 8%, may yield impact performance which does not meet the evaluation criteria of European Standard EN 1317:2000.

QUEST® DCM System

Limitations and Warnings (cont'd.)

The QUEST DCM 100/110 System has been tested and evaluated per the recommendations of the National Cooperative Highway Research Program (NCHRP) report 350.* The QUEST DCM 100/110 System is capable of: decelerating and stopping light and heavy weight vehicles (820 to 2000 kg [1804 to 4400 lb]) when impacted head-on at angles up to 15 degrees on the nose at 100 km/h [62.1 m.p.h.]; and redirecting heavy weight vehicles (2000 kg [4400 lb]) when impacted at 100 km/h [62.1 m.p.h.] along the system's side at 20 degrees or less. Tests are conducted on asphalt and concrete with slopes less than 8 degrees and without curbs.

A smooth transition must be provided when the QUEST DCM 100/110 System is installed in a bidirectional traffic situation.

Excessive curb height may create a ramping effect, which could create an unsafe vehicle trajectory.

After an impact occurs, the System should be repaired or replaced as soon as possible.

Contact Customer Service at 1-888-323-6374 for replacing Systems.

The QUEST DCM 70/80 System has been tested and evaluated per the recommendations of the National Cooperative Highway Research Program (NCHRP) report 350.* The QUEST DCM 70/80 System is capable of: decelerating and stopping light and heavy weight vehicles (820 to 2000 kg [1804 to 4400 lb]) when impacted head-on at angles up to 15 degrees on the nose at 70 km/h [44 m.p.h.]; and redirecting heavy weight vehicles (2000 kg [4400 lb]) when impacted at 70 km/h [44 m.p.h.] along the system's side at 20 degrees or less. Tests are conducted on asphalt and concrete with slopes less than 8 degrees and without curbs.

A smooth transition must be provided when the QUEST DCM 70/80 System is installed in a bidirectional traffic situation.

Excessive curb height may create a ramping effect, which could create an unsafe vehicle trajectory.

After an impact occurs, the system should be repaired or replaced as soon as possible.

For repair or for replacement, contact Customer Service at 1-888-323-6374.

Warning!

Impact conditions that differ from those described in the *NCHRP 350 test matrix for non-gating, redirective crash cushions may result in different crash results than those encountered in testing. Furthermore, impacts in excess of TL-3 impact severity or the existence of unusual impact conditions such as vehicle instability resulting from traversing curbs or excessive cross slopes prior to impact may compromise crash performance. Under these conditions, performance criteria relative to structural adequacy, occupant risk and vehicle trajectory may not meet NCHRP 350 evaluation criteria.

* Copy may be obtained from:
Transportation Research Board
National Research Council
2101 Constitution Avenue, N.W.
Washington, D.C. 20418

Warning!

Impact conditions that differ from those described in the *NCHRP 350 test matrix for redirective, non-gating crash cushions may result in different crash results than those encountered in testing. Furthermore, impacts in excess of TL-2 impact severity or the existence of unusual impact conditions such as vehicle instability resulting from traversing curbs or excessive cross slopes prior to impact may compromise crash performance. Under these conditions, performance criteria relative to structural adequacy, occupant risk and vehicle trajectory may not meet NCHRP 350 evaluation criteria.

* Copy may be obtained from:
Transportation Research Board
National Research Council
2101 Constitution Avenue, N.W.
Washington, D.C. 20418

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For more complete information on Valtir products and services, visit us on the web at www.valtir.com. Materials and specifications are subject to change without notice. Please contact Valtir to confirm that you are referring to the most current instructions.

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