July 6th, 2023, PHSS Fortier lateral protection - Project X00358 test # T22-65

Purpose of the test:

PHSS Fortier modified 3 existing components following CNRC's computerized analysis.

The principal points tested:

Validate structural capacity and it's point of rupture during a 90-degree collision following CNRC's completed research.
Measure the quantity energy absorption in a 90-degree collision.
Measure the vehicle's intrusion under the semi-trailer at a 90-degree collision.

CNRC's recommended alterations to existing components.

Extend point of attachment of the front brace to 1 more "I" beam
Additional support to front brace to add more stiffness.
Additional steel to close off vertical & horizontal support to connect both front braces.
Added a 45-degree steel brace.
Replace clips by simple washers in some parts of the structural attachment.

Preparation of the lateral protection device (see 3.2 in French version)

3.3 Height of push application

The standard mentions that the height of a bumper must be between 16 to 24 inches from the ground.

The maximum height above a semi-trailer bumper is 22 inches.
The center of a semi-trailer bumper is then at 24 inches from the ground.
Considering this information, the height of our test is 24 inches center.
(See 3.3.2 in French version)

3.4 Device utilized in our uniform trials.

Bumper of a massif steel Ranger pickup mounted on a load cell (see 3.4 in French version)

3.6 Utilized lab material.

Load cell 50000 lbs.
Tracker 200 pressure receiver
Tracker 220 displacement receiver
Tempo sonics stem clwg-600 (Celesco) 24 inches
Ford Ranger rear bumper
Telescopic forklift
Camera
Tripod

4. Trial 1

4.1 Methodology of trial #1

Excess force: Push to maximum destruction
Position: Center - between the two steel structures
Height: Push center at 24 inches from the ground
Device utilized for the force: Ford Ranger rear bumper.
Duration: Maximum time of push 5 minutes

4.2 Set up 1.

Tension on the straps: 400 Lb.-pi
Side: Passenger side

See French version 4.3 for pictures & screen shots of videos.

4.4 Graphic of T22-65 trial.

See French version.

4.5 Observations trial results

The skirt detaches from the aluminum extrusion.
No rupture from the straps even though they had been extended.
No deformation on the winches
Slight slide of the skirt towards the back
Ruptures of rear “I” beams
Rupture of front “I” beam
Slight deformation of aluminum bottom rail

Refer to 4.4 graphic for below comments in French version.

The sudden descent of the curb indicates a rupture and not a deformation of the sideguard. This is the rupture of several high beams which resulted in this first abrupt descent.
The small horizontal section which follows corresponds to the deformation of the "I" beam. This section continues until the rear high beams completely rupture.

6. Graphic explanations

During this trial, we measure the force of the push along with the deformation of the sideguard. This allows us to create a graphic of the force in function of the deformation.

Energy = Force x deformation

7. Comparing T22-65 (July 6th, 2023) to 2 previous trials (T17-37 & T22-54)

See French version for graphics.

The curb of T22-65 is more abrupt than the previous trails. This confirms that the structure is more rigid than previous version. In 2017, the trial demonstrated that it requires a force of 260 Lb. for each inch push of deformation. In 2022, the trial demonstrated that it requires a force of 209 Lb. for each inch of deformation. For our 2023 trial, it requires a force of 290 Lb. for each inch deformation. The structure of the test of T2-65 is more rigid than previous structures.

In turn, the semi-trailer has now become the failure point and not the sideguard itself.

8. Conclusion

This test had the objective:

Validate the structural capacity and its point of rupture of PHSS Fortier's sideguard during a lateral 90-degree collision following CNRC's terminated studies.
Measure the energy absorption by the sideguard during a 90-degree lateral collision.
Measure the level of intrusion under the semi-trailer by a vehicle during a 90-degree lateral collision.

The modifications done to the design permitted to increase the rigidity of the sideguard.

See French version for table:

In previous trials, it was always the same component which deformed first. In this present test (T22-65), it's the semi-trailer which gave out and not PHSS Fortier's sideguard.
The semi-trailer is constructed with high beams of 4 inches, in steel 80000 psi & distanced at 12 inches from one to the next.

If we take the energy it took in, this demonstrates that PHSS Fortier's sideguard can stop a vehicle with a total masse weight at a speed rate as follows:

See page 29 of French report.

The CNRC's report stipulates as follows:

Preliminary results from the validated numerical models demonstrate that the PHSS Fortier SUPD has the potential to improve the safety risks associated with the passenger car – trailer collisions at relative speeds up to approximately 12 mph.

That said, the results obtained during our T22-65 coincide with the affirmation of CNRC's for a vehicle of 1000 kg.

PHSS Fortier's sideguard can without a doubt absorb more energy, as in turn, it is the semi-trailer's structure which gave out first.