

Figure 1. Crash scene



Source: PR Newswire

Figure 2. IIHS moderate overlap test



Source: Insurance Institute for Highway Safety

In the Institute’s moderate overlap test, a vehicle travels at 40 mph toward a barrier with a deformable face. A Hybrid III dummy representing an average-size man is positioned in the driver seat. Forty percent of the total width of the vehicle strikes the barrier on the driver side. The forces in the test are similar to those that would result from a frontal offset crash between two vehicles of the same weight, each going just under 40 mph.

How does the test with non-OEM parts compare with the IIHS test of the Honda Fit?

The Tracy Law Firm and the Auto Body Association of Texas subsequently commissioned three crash tests of Honda Fits. The tests attempted to show that aftermarket parts should be avoided, and that shops should use OEM-approved methods and parts for repairs. The contract lab, Karco Engineering, ran three moderate overlap front tests. (Karco has conducted crash tests for automakers and the National Highway Traffic Safety Administration.) Karco ran one test with a 2010 Fit (unmodified) as a control. A second test used a 2009 Fit with a replacement roof panel glued on instead of welded, with an aftermarket windshield installed to represent the real-world crash subject to litigation. A third test used a 2013 Fit outfitted with various aftermarket parts, including Certified Automotive Parts Association (CAPA) certified fenders and a hood, a noncertified radiator support, two hood hinges and a bumper reinforcement beam, along with an aftermarket windshield and driver-side front wheel. The test results were released publicly on February 6, 2018.

Structurally, the results of the control (2010 Fit) and aftermarket parts (2013 Fit) tests look roughly similar to the 2009 Honda Fit test IIHS performed in 2008 as shown in Figure 3. The IIHS test was an audit of Honda’s own test of the Fit submitted to the Institute as part of the ratings verification process. Consequently, there are three tests of unmodified Fit cars to compare with the Karco tests of a car repaired with non-OEM repair parts.

Figure 3. Door closure, IIHS 2009 Honda Fit (left); 2010 Fit OEM (middle) and 2013 Fit equipped with aftermarket parts (right)



Source: Insurance Institute for Highway Safety

Source: Karco Engineering

Structural intrusion into the occupant compartment is a key factor in determining vehicle crashworthiness. To assess a vehicle's structural performance, IIHS protocol calls for measuring the amount of intrusion into the occupant compartment at key locations in the interior and exterior of the vehicle after the crash. The amount and pattern of intrusion show how well the front-end crush zone managed the crash energy and how well the safety cage held up.

Table 1 shows the intrusion measures from Honda Fit tests performed by Karco, IIHS and Honda. The test of the 2013 Fit resulted in more intrusion of the left and center toepan and brake pedal than any of the tests of unmodified cars. Despite these differences, the measurements from all four tests represent structural performance that would be rated good according to IIHS protocol.

Table 1. Structure (intrusion measures) for Honda Fit

	IIHS test 2009 Fit	Honda test 2009 Fit	Karco test 2010 Fit	Karco test 2013 Fit with non- OEM repair parts
Footrest (cm)	6	3	5	7
Left toepan (cm)	10	5	8	17
Center toepan (cm)	13	5	10	18
Brake pedal (cm)	9	7	8	12
Left instrument panel (cm)	1	1	0	1
Right instrument panel (cm)	1	0	0	1
A-B pillar closure (cm)	1	0	1	1*

* The value stated in the Karco test reports was 12; however, after checking with engineers at Karco, IIHS learned that this was an error. The value reported here is based on IIHS digital analysis of test report photos.

Measures from sensors in the test dummy are important to evaluating the risk of injury to the monitored body regions. Tracy, on his website and in trade publications, has pointed out variation in head, neck and leg injury measures in the tests as an indication of subpar performance. Table 2 shows some of these measures and the available corresponding measures from the IIHS and Honda tests.

Table 2. Injury measures for Honda Fit

	IIHS test 2009 Fit	Honda test 2009 Fit	Karco test 2010 Fit	Karco test 2013 Fit with non- OEM repair parts
Head injury criterion	264	335	283	332
Max. neck X-force* (N)	294	n/a	306	465
L. femur compression force (N)	400	400	180	1700
R. foot acceleration (g)	62	63	102**	173**

* shearing force across the neck

** These are "toe" acceleration values indicated in the Karco crash test reports, rather than those highlighted in the Tracy Law Firm videos.

Although some of the differences between the tests of the unmodified cars and the test of the 2013 model with non-OEM parts seem large, none of the measures shown in Table 2 represent a high risk of a severe injury. (Foot/toe accelerations aren't related to injury risk.) The HIC values in Table 2, for example, all represent a less than 1 percent risk of severe head injury.

Similarly, the compression forces recorded on the left femur in all four tests also are well below the level (7,300 N) at which the IIHS protocol would downgrade its assessment of protection for the knee, thigh and hip because serious injuries, including fractures, wouldn't be expected below this level. In fact, a force of 10,000 N is a passing grade for regulatory frontal crash tests. Charts in the Karco test reports show that all the injury measures used by IIHS for

injury risk evaluation are below the threshold for a downgrade from a good to an acceptable rating. These, as well as the corresponding chart from the Institute's test, are appended to this Advisory (see Appendix).

Table 3 shows the ratings IIHS would assign the Karco tests, using the available data, photographs and video, as we would a verification test from an OEM, along with ratings given to the IIHS/Honda tests of the Fit.

Table 3. IIHS ratings for Honda Fit

	IIHS test 2009 Fit	Honda test 2009 Fit	Karco test 2010 Fit	Karco test 2013 Fit with non- OEM repair parts
Structure	G	G	G	G
Injury measures				
Head/neck	G	G	G	G
Chest	G	G	G	G
Left leg	G	G	G	G
Right leg	G	G	G	G
Restraints and kinematics	G	G	G	G
Overall	G	G	G	G

G Good **A** Acceptable **M** Marginal **P** Poor

Can the differences between Karco's non-OEM parts test and the control test (or IIHS/Honda tests) results be attributed to the non-OEM parts?

It is important to consider the range of test measures in exactly repeated experiments in order to determine whether changes in the conditions of subsequent tests, such as swapping non-OEM repair parts for the original, change the expected results. IIHS has been crash testing vehicles since 1995 and has addressed the subject of test repeatability — that is, do repeated tests produce similar results? In 1998, IIHS engineers examined the repeatability of the moderate overlap front test. Engineers observed differences in HICs, ranging from 17 to 73 across four comparisons. Left femur compression differed by as much as 700 N in repeated tests. Measures of intrusion at the footrest, left and center toe pan and brake pedal varied by 6, 8, 7 and 5 centimeters, respectively, across seven comparisons. Left and right instrument panel intrusion varied by up to 9 centimeters, and the A-to-B-pillar measure varied by as much as 11 cm across the same seven pairs of tests. Thus, the left femur compression force and the toe pan intrusion measures in the test with non-OEM repair parts are the only reported measures that differed from Karco's control test by more than would be expected between two exactly replicated tests. In the case of the toe pan intrusion measures, the differences when compared with the IIHS test of the Fit are within the expected range of variability.

Discussion and conclusion

It is possible that replacing the bumper reinforcement, radiator support and left front wheel with non-OEM alternatives in the test of the 2013 Fit resulted in somewhat more toe pan intrusion and a slight degradation of protection for the driver's left knee/thigh/hip and right foot/ankle. These were the only measurements reported by Tracy and Karco that varied from the baseline results by more than would be expected in exactly repeated crash tests. Even though these and other measures indicate a somewhat increased risk of injury compared with the test of an unmodified Honda Fit, the overall rating for the cars in both tests would be good according to IIHS protocol and consistent with our own test.

Replacing the hood and fenders with CAPA-certified parts is unlikely to have influenced the results of this test. Previous IIHS testing in 1987 and again in 2000 illustrated that cosmetic parts have no influence on crashworthiness, so their origin is irrelevant. These tests also have shown that non-OEM hoods copied with the care needed to earn CAPA certification perform similarly to the original equipment in crash tests. The main concern

about hoods in frontal crashes is that they not be driven back through the windshield into the occupant cabin, and this problem hasn't been identified in the Karco crash test reports for Tracy.

The use of particular non-OEM repair parts in the 2013 Fit may have contributed to differences in crash test results compared with the control tests. However, these results pertain only to the parts used in the Karco Fit tests in question, and not the use of non-OEM parts in general. Tests conducted by IIHS in 2010 show that structural components can be copied with sufficient fidelity to preserve crashworthiness following repair of a damaged vehicle.

Finally, it also is possible that other unreported differences between the Karco test of the 2013 Fit with non-OEM parts and the comparison crash tests may be responsible for the elevated left femur force and right foot acceleration. The Institute's examination of the results from the tests doesn't change its previous conclusions that cosmetic parts are irrelevant to crashworthiness and that with proper care and attention to detail, non-OEM structural replacements can be used safely.

For more information, see:

Huetter, J. (2017, October 2). Texas auto body shop owes \$31.5M for incorrect repair tied to fiery crash. *Repairer Driven News*. Retrieved from <http://www.repairerdrivennews.com/2017/10/02/jury-awards-42m-over-incorrect-texas-auto-body-repair/>

Huetter, J. (2018, January 3). Tracy: Tests provide 'scientific and engineering' proof against non-OEM parts, alternative repairs. *Repairer Driven News*. Retrieved from www.repairerdrivennews.com/2018/01/03/tracy-tests-provide-scientific-and-engineering-proof-against-non-oem-parts-alternative-repairs/

Huetter, J. (2018, January 9). Tracy: Effects of aftermarket parts, glued roof felt by test Honda Fits' drivers, frames. *Repairer Driven News*. Retrieved from www.repairerdrivennews.com/2018/01/09/tracy-effects-of-aftermarket-parts-glued-roof-felt-by-test-honda-fits-drivers-frames/

Huetter, J. (2018, February 6). Tracy releases all data from Honda Fit crash tests; download it here. *Repairer Driven News*. Retrieved from www.repairerdrivennews.com/2018/02/06/tracy-releases-all-data-from-honda-fit-crash-tests-download-it-here/

Insurance Institute for Highway Safety. (1987). Cosmetic replacement parts and auto repair practices. Advisory, 1.

Insurance Institute for Highway Safety. (1987). Removing cosmetic repair parts has no effect on compliance, crash test shows. Advisory, 2.

Insurance Institute for Highway Safety. (2000). Cosmetic repair parts are irrelevant to auto safety. *Status Report*, 35(2).

Insurance Institute for Highway Safety. (2000). Two earlier crash tests showed crash parts don't affect safety. *Status Report*, 35(2).

Insurance Institute for Highway Safety. (2009). Honda Fit ratings. Retrieved from www.iihs.org/iihs/ratings/vehicle/v/honda/fit-4-door-wagon/2009

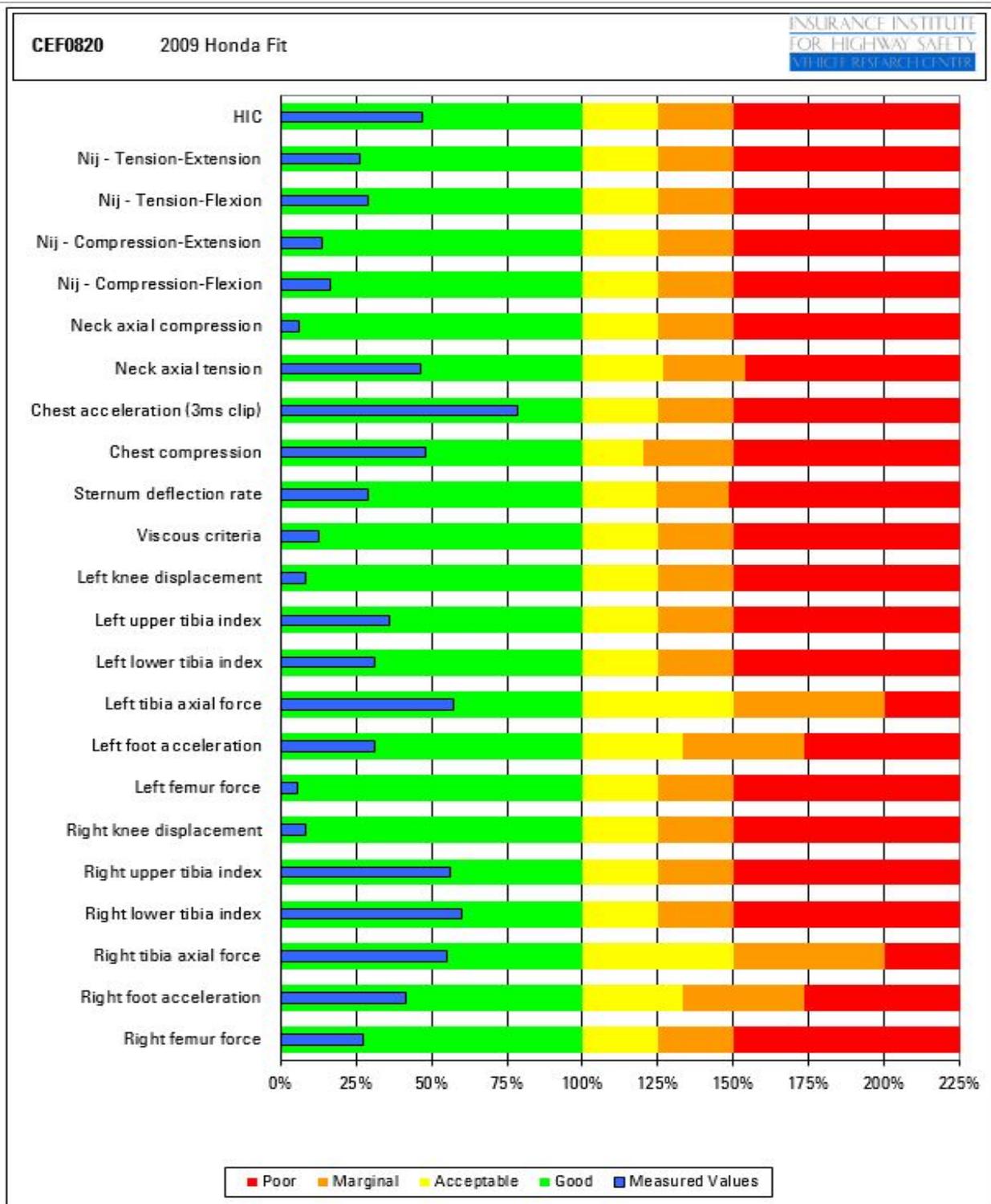
Insurance Institute for Highway Safety. (2010). Aftermarket bumpers meeting new standard perform well in crashes. *Status Report*, 45(11).

Insurance Institute for Highway Safety. (2014). Moderate overlap frontal crashworthiness evaluation guidelines for rating injury measures. Retrieved from http://www.iihs.org/media/dcc9d5d6-c301-4f92-a7b5-dad13ffc7766/6h8G8A/Ratings/Protocols/current/measures_frontal.pdf&sa=U&ved=0ahUKEwiGhcm8mqHZAhWItVkKHWHOAScQFggEMAA&client=internal-uds-cse&cx=001263129772496713041:qpkzn11xmow&usg=AOvVaw3bfyf-oNFVodiS6VyXVeIB

Insurance Institute for Highway Safety. (2017). Moderate overlap crash test protocol. Version XVIII. Retrieved from http://www.iihs.org/media/f70ff6eb-d7a1-4b60-a82f-e4e8e0be7323/NXIOUQ/Ratings/Protocols/current/test_protocol_high.pdf

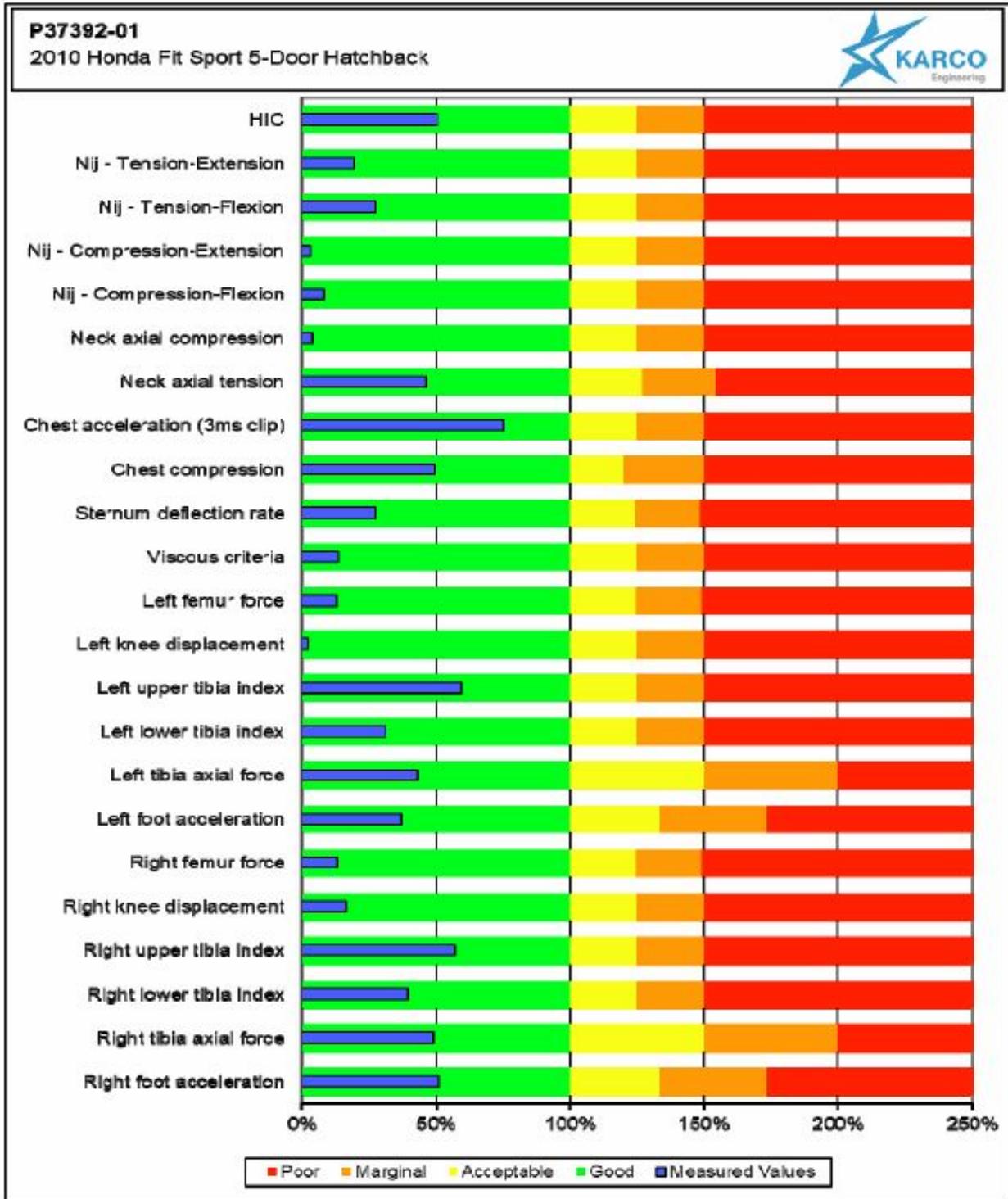
Appendix. Injury measures

Figure A1. IIHS 2009 Honda Fit – Test CEF0820



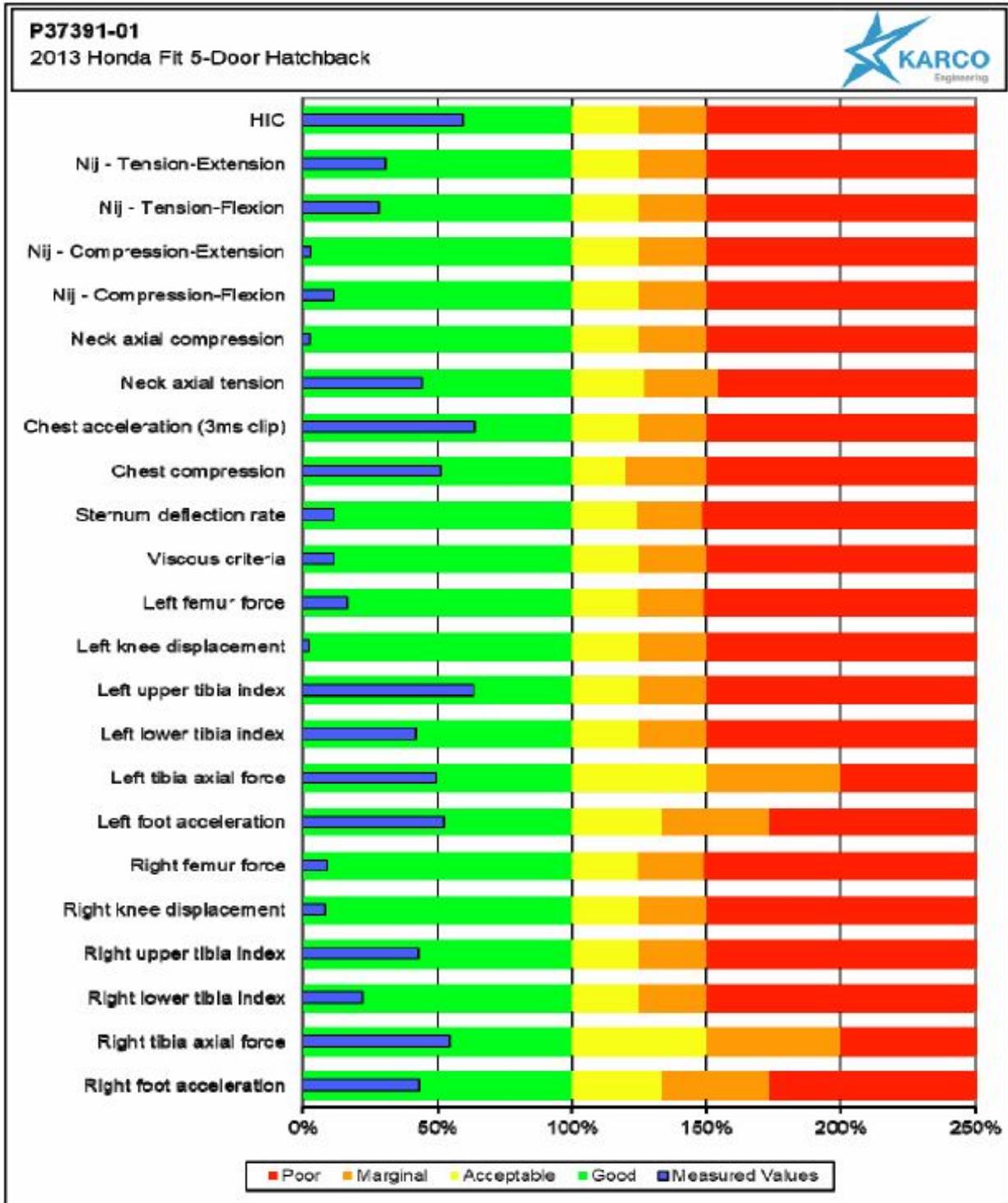
Source: Insurance Institute for Highway Safety

Figure A2. Tracy 2010 Honda Fit, control – Test P37392-01 (Performed by Karco Engineering)



Source: Karco Engineering

Figure A3. Tracy 2013 Honda Fit, w/non-OEM parts – Test P37391-01 (Performed by Karco Engineering)



Source: Karco Engineering