



HYTORC REACTION WASHER



HYTORC BACKUP WASHER

HYTORC WASHER ASTM F3394/F3394M STANDARD

The HYTORC Washer system provides instant improvements in safety, speed and accuracy for most every bolting application. The HYTORC Reaction Washer and Backup Washer, when used with compatible tools, eliminate the need for reaction arms, backup wrenches and dangerous pinch points. When used as a system the HYTORC Washer provides improved speed and accuracy on every bolting job. The HYTORC Washer is manufactured in accordance with the requirements in the ASTM F3394/F3394M standard.

SAFETY



The HYTORC Reaction Washer eliminates the need for reaction arms, which are the most common cause of injury on bolting jobs. The unique design of the washer allows the dual socket driver to react on the washer, while turning the nut.

SPEED



The HYTORC Backup Washer eliminates the need for backup wrenches improving the speed and efficiency of the overall bolting operation. The unique knurl design ensures the backup washer and back nut will not rotate during tightening.

ACCURACY



The HYTORC Washer System provides optimal axial tool alignment resulting in improved repeatability, reduced bolt load scatter and increased accuracy.

ASTM F3394/F3394M STANDARD SPECIFICATION FOR HARDENED STEEL BACKUP AND REACTION WASHERS INCH AND METRIC DIMENSIONS

The HYTORC Washer is manufactured in accordance with the requirements in the ASTM F3394 Standard Specification for Hardened Steel Backup and Reaction Washers. This standard covers general-purpose mechanical and structural use of washers with bolts, nuts, studs, Direct Tension Indicator washers and other threaded fasteners.

This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.



Designation: F3394/F3394M - 20

Standard Specification for Hardened Steel Backup and Reaction Washers Inch and Metric Dimensions^{1,2}

This standard is issued under the fixed designation F3394/F3394M; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscripted question mark (?) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This specification covers the chemical, mechanical, and dimensional requirements for hardened steel Backup and Reaction washers for use with fasteners having nominal diameters of 1/8 in. through 3 in. and M14 through M80. These washers are intended for general-purpose mechanical and structural use with bolts, nuts, studs, DTIs, and other internally and externally threaded fasteners. These washers are suitable for use with fasteners covered in Specifications A354, A193/A193M, A194/A194M, A320/A320M, F959/F959M, A449, A563, A563M, and F3125.

1.2 The washers are designated by style denoting the shape, by type denoting the material, and by inch or metric dimensions.

1.2.1 The styles of washers covered are:

1.2.1.1 *Reaction*—Circular washers with a knurled surface on one side and a contoured outside diameter designed to couple with the installation tool.

1.2.1.2 *Backup*—Circular washers having a knurled surface on both sides.

1.2.2 The types of washers covered are:

1.2.2.1 *Type 1*—Medium Carbon or Medium Carbon Alloy Steel.

1.2.2.2 *Type 3*—Weathering steel. This specification provides for furnishing Type 3 to chemical composition or a Corrosion Index (CRI) of 6 or higher, at the supplier's option.

1.3 The values stated in either inch-pound units for inch fasteners and SI units for metric fasteners and are to be regarded separately as standard. The values stated in each system may not be exact equivalents; therefore, each system

shall be used independently of the other. Combining values from the two systems may result in non-conformance with the standard.

1.4 This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.

1.5 This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.

2. Referenced Documents

2.1 ASTM Standards:³

A193/A193M Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications

A194/A194M Specification for Carbon Steel, Alloy Steel, and Stainless Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both

A320/A320M Specification for Alloy-Steel and Stainless Steel Bolting for Low-Temperature Service

A354 Specification for Quenched and Tempered Alloy Steel Bolts, Studs, and Other Externally Threaded Fasteners

A449 Specification for Hex. Cap Screws, Bolts and Studs, Steel, Heat Treated, 120/105/90 ksi Minimum Tensile Strength, General Use

A563 Specification for Carbon and Alloy Steel Nuts (Metric)

A563M Specification for Carbon and Alloy Steel Nuts (Metric)

A588/A588M Specification for High-Strength Low-Alloy Structural Steel, up to 50 ksi [345 MPa] Minimum Yield Point, with Atmospheric Corrosion Resistance

A751 Test Methods, Practices, and Terminology for Chemical Analysis of Steel Products

¹ This specification is under the jurisdiction of ASTM Committee F16 on Fasteners and is the direct responsibility of Subcommittee F16.02 on Steel Bolts, Nuts, Rivets and Washers.

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² Backup and Reaction washers of the type covered by this standard have a patent application pending. Intellectual parties are invited to submit information regarding the identification of an alternative(s) to these patent-pending items to the ASTM International Headquarters. Your comments will receive careful consideration as a meeting of the responsible technical committee, which you may attend.

³ For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For Annual Book of ASTM Standards volume information, refer to the standard's Document Summary page on the ASTM website.

ASTM ORGANIZATIONAL MEMBER

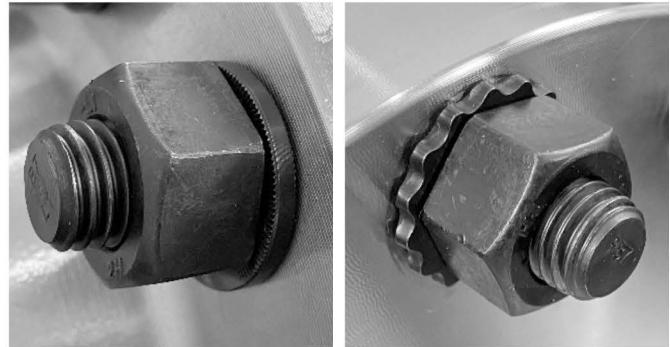
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ASTM standards help to improve the lives of millions every day by enhancing public safety and consumer confidence in over one hundred industries.

As an ASTM Organizational member, HYTORC is proud to have been a leading contributor to the new ASTM F3394 standard for hardened steel backup & reaction washers.



INSTALLATION TIPS



1. Allow 3/4" (19 mm) extra bolt length for the thickness of the reaction and backup washers.
2. Your current bolts and nuts can be used with HYTORC Washers.
3. All nuts can still be tightened or loosened using your preferred bolting method; not exclusive to HYTORC tooling.

WHERE TO GET THE ASTM STANDARD

This standard is available from the ASTM store:
astm.org/Standards/F3394

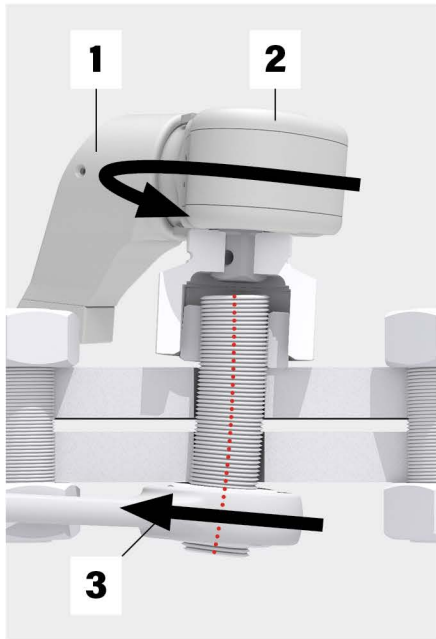
STANDARD HIGHLIGHTS

The ASTM F3394/F3394M covers:

- Reaction and Backup Washer description
- Medium Carbon and Weathering steels
- Coatings
- Mechanical properties
- Dimensions in imperial and metric
- Workmanship, finish, quality and appearance.
- Product marking
- Packaging and package marking

SYSTEM COMPARISON

CONVENTIONAL BOLTING CONFIGURATION

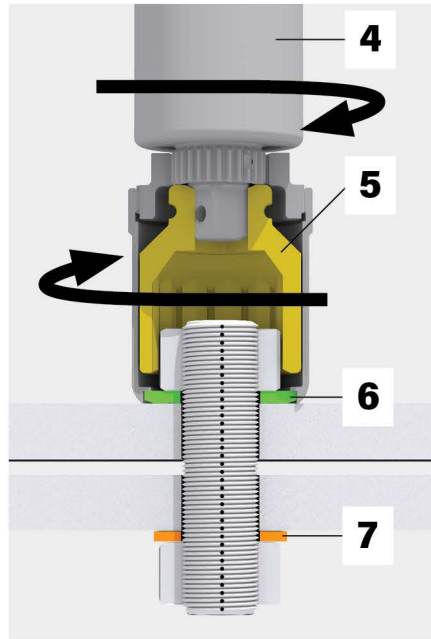


Conventional Bolting configuration:

- 1) Reaction fixture
- 2) Torque wrench
- 3) Backup wrench

Torque Application with conventional torque wrench, reaction arm and backup wrench creates significant side load, distortion of axial alignment, increases bolt load scatter and decreases accuracy.

HYTORC WASHER BOLTING CONFIGURATION



HYTORC Washer System:

- 4) Torque wrench
- 5) Dual socket driver
- 6) Reaction Washer
- 7) Backup Washer

The use of the HYTORC Washer system eliminates side load distortion, improves axial alignment, reduces bolt load scatter and improves overall accuracy.

CONVENTIONAL BOLTING EFFORT AND RISK



Conventional bolting practices require additional effort and coordination while increasing the risk of injury.

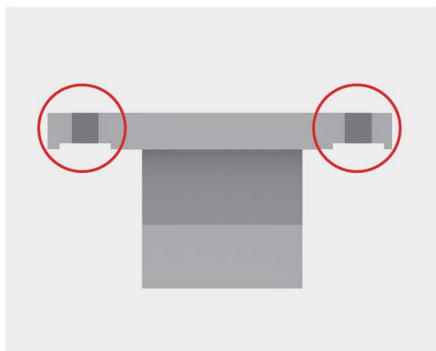
HYTORC WASHER IMPROVES SAFETY AND EFFICIENCY



The HYTORC Washer System greatly simplifies bolting operations by eliminating reaction arms, backup wrenches and associated coordination.

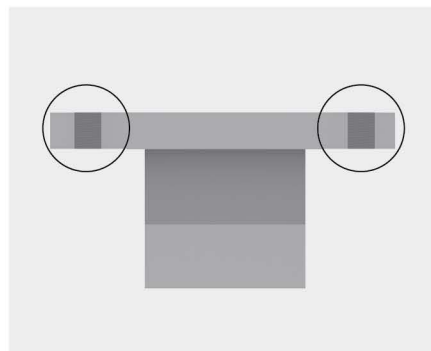
The combined use of the HYTORC Washer and compatible tools improves safety and efficiency.

RE-MACHINED/DAMAGED FLANGE SURFACE

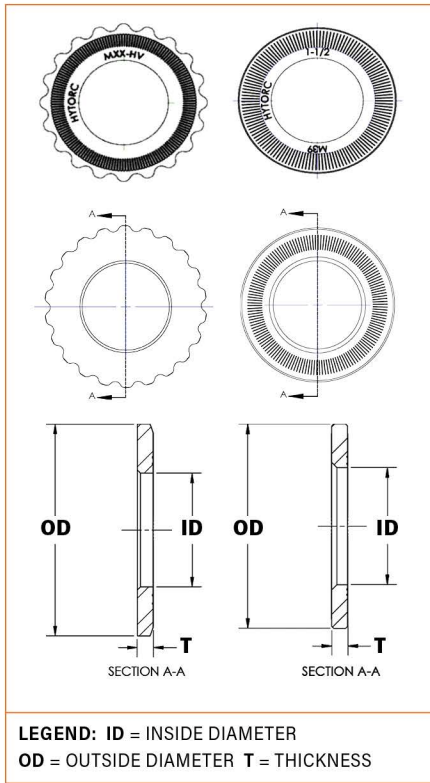


Repeated tightening and loosening of nuts without the use of a washer will cause extended wear and damage to the flange, requiring costly re-machining during maintenance activities.

FLANGE PROTECTION



The HYTORC Washer protects flange surfaces, eliminating the need for expensive resurfacing and extending flange life.



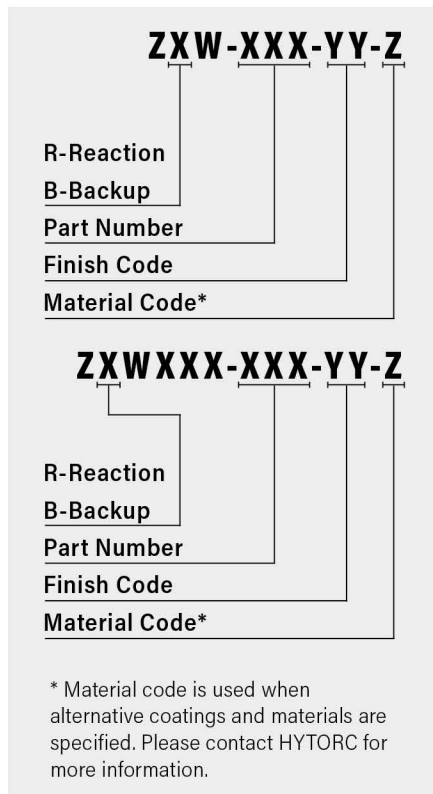
REACTION WASHER - IMPERIAL (in.)

BOLT SIZE	PART NUMBER	ID	OD	T
1/2"	ZRW-008	0.531	1.118	0.123
9/16"	ZRW-009	0.625	1.219	0.123
5/8"	ZRW-010	0.688	1.432	0.130
3/4"	ZRW-012	0.813	1.600	0.152
7/8"	ZRW-014	0.938	1.865	0.152
1"	ZRW-100	1.063	2.057	0.158
1-1/8"	ZRW102-M30	1.241	2.307	0.190
1-1/4"	ZRW104-M33	1.346	2.492	0.190
1-3/8"	ZRW106-M36	1.497	2.742	0.190
1-1/2"	ZRW108-M39	1.592	2.928	0.190
1-5/8"	ZRW110-M42	1.703	3.179	0.245
1-3/4"	ZRW112-M45	1.823	3.355	0.245
1-7/8"	ZRW114-M48	1.977	3.617	0.245
2"	ZRW200-M52	2.135	3.787	0.245
2-1/4"	ZRW204	2.341	4.280	0.298
2-1/2"	ZRW208-M64	2.662	4.768	0.335
2-3/4"	ZRW-212	2.863	5.265	0.335
3"	ZRW-300	3.117	5.595	0.405

BACKUP WASHER - IMPERIAL (in.)

BOLT SIZE	PART NUMBER	ID	OD	T
1/2"	ZBW-008	0.531	1.005	0.120
9/16"	ZBW-009	0.625	1.086	0.120
5/8"	ZBW-010	0.688	1.227	0.130
3/4"	ZBW-012	0.813	1.449	0.150
7/8"	ZBW-014	0.938	1.650	0.150
1"	ZBW-100	1.063	1.870	0.160
1-1/8"	ZBW102-M30	1.236	2.092	0.190
1-1/4"	ZBW104-M33	1.346	2.309	0.190
1-3/8"	ZBW106-M36	1.492	2.526	0.190
1-1/2"	ZBW108-M39	1.592	2.742	0.190
1-5/8"	ZBW110-M42	1.703	2.959	0.250
1-3/4"	ZBW112-M45	1.818	3.175	0.250
1-7/8"	ZBW114-M48	1.972	3.392	0.250
2"	ZBW200-M52	2.130	3.608	0.260
2-1/4"	ZBW204-M56	2.336	4.120	0.300
2-1/2"	ZBW208-M64	2.657	4.500	0.340
2-3/4"	ZBW212-M72	2.858	4.920	0.340
3"	ZBW-300	3.112	5.250	0.410

PART DESIGNATION



REACTION WASHER - METRIC (mm)

BOLT SIZE	PART NUMBER	ID	OD	T
M14	ZRW-M14	14.99	28.40	3.1
M16	ZRW-M16	16.99	30.96	3.1
M18	ZRW-M18	19.23	36.37	3.3
M20	ZRW-M20	21.11	37.01	3.3
M22	ZRW-M22	23.09	40.64	3.3
M24	ZRW-M24	25.32	47.37	4.1
M27	ZRW-M27	28.70	52.25	4.1
M30	ZRW102-M30	31.39	58.60	4.8
M33	ZRW104-M33	34.19	63.30	4.8
M36	ZRW106-M36	37.90	69.65	4.8
M39	ZRW108-M39	40.44	74.37	4.8
M42	ZRW110-M42	43.26	80.75	6.4
M45	ZRW112-M45	46.18	85.22	6.4
M48	ZRW114-M48	50.09	91.87	6.4
M52	ZRW200-M52	54.10	96.19	6.4
M60	ZRW-M60	64.01	108.71	7.6
M64	ZRW208-M64	67.49	121.11	8.6
M68	ZRW-M68	70.10	121.11	8.6
M72	ZRW-M72	73.91	133.73	8.6
M76	ZRW-M76	77.98	133.73	8.6
M80	ZRW-M80	82.04	142.11	10.0

BACKUP WASHER - METRIC (mm)

BOLT SIZE	PART NUMBER	ID	OD	T
M14	ZBW-M14	14.99	25.53	3.1
M16	ZBW-M16	16.99	27.58	3.1
M18	ZBW-M18	19.23	31.17	3.3
M20	ZBW-M20	21.11	34.65	3.3
M22	ZBW-M22	23.09	36.8	3.9
M24	ZBW-M24	25.32	41.91	4.0
M27	ZBW-M27	28.7	47.5	4.0
M30	ZBW102-M30	31.39	53.14	4.8
M33	ZBW104-M33	34.19	58.65	4.8
M36	ZBW106-M36	37.90	64.16	4.8
M39	ZBW108-M39	40.44	69.65	4.8
M42	ZBW110-M42	43.26	75.16	6.4
M45	ZBW112-M45	46.18	80.65	6.4
M48	ZBW114-M48	50.09	86.16	6.4
M52	ZBW200-M52	54.10	91.64	6.4
M60	ZBW-M60	59.33	104.65	7.4
M64	ZBW208-M64	67.49	114.30	8.5
M68	ZBW-M68	70.10	114.30	8.5
M72	ZBW212-M72	72.59	124.97	8.5
M76	ZBW-M76	77.98	124.97	8.5
M80	ZBW-M80	82.04	133.35	10.3

Nominal dimensions for reference only.

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