Supplemental Thread Sealant Performance Testing: Loctite 5772

Performance of Loctite 5772 Thread Sealant on Stainless-to-Stainless and Stainless-to-Carbon Steel Pipe Fitting Connections
Addendum to EPRI Report 1000972, Assembling Threaded Connections (December 2000)

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ABSTRACT

Prior EPRI research on the relative performance of various commercial pipe thread sealants indicated that a particular product, Loctite 5772, performed substantially better than all competing products in affecting a leak-tight seal on carbon steel-to-carbon steel pipe fittings in operating environments with temperatures less than 300˚F. Further, the prior research demonstrated that Loctite 5772 could develop an effective leak-tight seal with only six (6) hours of cure time. While subsequent field experience has proven these observations to be true, it has also raised the question as to whether this same performance expectation holds true for stainless-to-stainless steel and stainless-to-carbon steel fitting configurations as well. This report summarizes the results of supplemental testing conducted on Loctite 5772 at EPRI's Fluid Sealing Technology Lab in Charlotte, North Carolina, to determine whether the same performance expectation holds true for these additional material combinations as proven for carbon steel-to carbon steel fittings.

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1 INTRODUCTION

In 1998-99 timeframe, utility members of EPRI's Fluid Sealing Technology Working Group (FSTWG) requested that EPRI investigate perceived problems with unacceptable numbers of industry leakage events from threaded piping connections. Among the outcomes, this led to development of an EPRI research project to identify and test a broad cross-section of commercially-available pipe thread sealants regularly in use by the nuclear industry. Samples were obtained from each thread sealant manufacturer, and test samples made from carbon steel pipe fittings were assembled to simulate real-world installation conditions. In addition to nitrogen, a variety of tests were conducted using contained fluids that included both natural and synthetic lube oils, hydraulic fluid, and water. This effort resulted in the publication of EPRI report 1000972, *Assembling Threaded Connections*, in December 2000.

A key highlight contained in that report is the identification of a particular pipe thread sealant – Loctite 5772 – that generally performed significantly better than all other sealants tested, leading to an EPRI recommendation, in the form of follow-on technical guidance, that EPRI members consider the potential for 5772 to resolve existing threaded connection leakage issues at each member's plants. As a result of this recommendation and shift in EPRI technical guidance beginning in 2001, EPRI member plants using 5772 on a consistent basis have since anecdotally reported a significant reduction in the number of threaded connection leaks where 5772 was used as the thread sealant.

Another of important highlight resulting from the above testing was the discovery that – while successful at eliminating leakage events under all conditions tested when used according to manufacturer's recommendations requiring a twenty-four (24) hour cure time – 5772 was equally successful at preventing leakage events with cure times as low as six (6) hours. This discovery had natural implications and importance for improving the performance of critical path activities of threaded connection assembly at power plants.

Over several years of subsequent experience, plant maintenance personnel at EPRI member plants began to notice that 5772 did not, in fact, work flawlessly under all circumstances at the reduced cure time of six (6) hours. Once again, anecdotal evidence began to suggest that this gap in expected performance might be the result of (i) use on stainless steel fittings, (ii) adjustment of the pipe joint after the joint was initially assembled, or (iii) both factors combined.

Project Basis

While the successful EPRI thread sealant testing conducted in 2000 included a provision for 'backing off' [adjusting] pipe nipples from their associated fitting after a one (1) hour post-assembly interval and a six (6) hour cure time, it did not test these factors in combination with the use of stainless steel pipe fittings.

Accordingly, a requirement evolved to conduct some confirmation testing – similar to the previous tests conducted by EPRI in 2000 – to establish the relative performance of 5772 when used with loosely assembled stainless steel piping components at a reduced cure time of six (6) hours.

In 2005, plant personnel at Exelon Corporation's Braidwood nuclear power station decided to address this requirement by funding an EPRI research project, to be completed before Braidwood's spring '06 refueling outage, to investigate this combination of factors and establish to what degree these factors, alone or in combination, might affect the sealability of 5772 under real-world conditions. The project was referred for action to EPRI's Maintenance Center, located in Charlotte, North Carolina USA.

Project Scope

The project scope was to generally follow a streamlined version of the prior EPRI thread sealant testing conducted in 2000, with the main difference being that only the 5772 product would be tested. In addition, the prior testing suggested that the contained fluids used in the various tests did not appear to have any significant effect upon the sealability of 5772. None the less confirmation of this apparent fact was included in the current test plan. As with the previous testing, contained fluids included nitrogen (for the preliminary short-term screening tests), and Mobil DTE Light (natural lube oil), Mobil SHC 624 (synthetic lube oil), Fyrquel (hydraulic fluid), and water. The latter four fluids were used in the long-term performance tests.

(Ed. Note: It appears that the Mobil SHC 624 sample was incorrectly identified as a Shell Oil Co. product in the earlier EPRI report 1000972.)

Project Objective

The primary project objective was to establish whether or not 5772 could be effectively used to seal stainless steel pipe fittings at a cure time of six hours, and if so, under what conditions, and with what degree of success. Guidance provided by Exelon during the initial stages of the project suggested that it was of greater interest to achieve the above objective than to expend limited resources in trying to establish the minimum cure time for 5772 under varying conditions.

2
RESEARCH APPROACH

The following sections describe the facilities, materials, and equipment used to conduct this research.

Facilities, Materials, and Equipment

Testing was conducted at EPRI's Fluid Sealing Technology Lab, located at EPRI-Charlotte (NC). The testing would use much of the same test equipment and similarly configured test specimens as used in the original EPRI thread sealant testing in 2000, with the exception that the use of stainless steel pipe fittings would be introduced as an additional factor.

The previous EPRI equipment was refurbished as necessary and tested, and a new temperature-controlled environmental chamber was designed and fabricated to support this research. New piping components (nipples, couplings) were purchased from a commercial supplier, McMaster-Carr, and thread areas were grit-blasted at EPRI to a consistent finish. (See Figure 1) New test samples were configured using a combination of newly-acquired stainless steel fittings in combination with old carbon steel fittings refurbished from the previous test program.

Figure 1
Test Specimen Piping Components

Samples of the Mobil DTE Light and SHC 624 oils to be contained were purchased from a commercial source. The compressed nitrogen gas, water, and Fyquel were on hand in the Fluid Sealing Technology Lab at EPRI-Charlotte. Fresh product samples of thread sealant 5772 and Loctite Primer 7649 were supplied by the vendor, Henkel Loctite Technologies, Hartford, CT.

According to Loctite, Loctite 5772 was developed from Loctite 577 sealant expressly for use in the nuclear power industry, with the only difference between the two products being that Loctite has altered their manufacturing process for 577 such that residual halides, fluorides, and chlorides are less that 100ppm, resulting in the 5772 designation for the nuclear-grade product. Loctite primer 7649 contains a mild solvent capable of cleaning moderate amounts of oils and other contaminants from the thread surface to be sealed, along with ionic copper that provides some reactivity to generally non-reactive metals such as stainless steel. The copper element is necessary in order to react with the anaerobic 5772 sealant, causing it to bond to the ordinarily non-reactive metal surfaces, thereby affecting a seal.

Test Specimen Preparation

Initially, the sealing surface of each piping component to be used in assembling test specimens was grit-blasted to remove any traces of foreign materials and to provide a consistent surface finish to receive the sealant application.

A combination of stainless steel pipe nipples, stainless steel couplings, and carbon steel nipples were used to prepare the test specimens. Each specimen consisted of a stainless steel nipple and a carbon steel nipple (See Figure 1) threaded into opposing sides of a stainless steel coupling. (For continuity, the stainless steel nipple was always oriented as the top nipple in the vertical specimen.) This arrangement provided a stainless-to-stainless and stainless-to-carbon steel threaded joint in each test specimen. The bottom (carbon steel) end of each specimen was seal welded, with a double O-ring seal configured at the top end of each specimen.

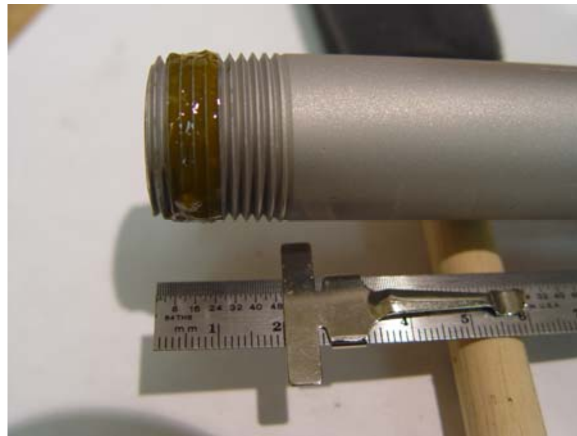

Figure 2
Thread Sealant Application

Some test specimens were assembled with a clean thread finish (grit-blasted), while the thread area of other specimens was wiped with a cloth soaked in SAE 30 motor oil, to simulate a non-solvent cleaned condition. Excess oil was wiped from the thread forms before application of the thread sealant and assembly of the joint.

On applying the thread sealant, the needle applicator of the 5772 container was held perpendicular to, and hard against, the thread form of each pipe nipple. (*NOTE: Through previous experimentation, it was found that if the applicator tip was held away from, or at an angle to, the intended thread form, the 5772 gel had a tendency to sit atop – rather than fill – the thread form. Thus on assembly, a substantial portion of the thread sealant would simply be pushed back up the nipple as it was threaded into the coupling.*) By depressing the bellows applicator and using a back-and-forth sweeping motion across the threads, the thread sealant was injected down into the thread form 360˚ around the nipple, for a width of three to four (3-4) threads (~0.25-in), beginning 1-2 threads back from the open nipple end. (See Figure 2)

Figure 3
Test Specimen Assembly

Sufficient test specimens were assembled to provide two (2) samples for each condition tested.

To assemble a test specimen, the pipe coupling was inserted into a pipe vise using sufficient pressure to hold the coupling firmly in place without deforming the fitting. The nipple thread area was inspected for thread damage that might significantly increase thread friction on assembly, and if none was found, the clean threads were either wiped with the oily cloth or not, depending upon the requirements for each individual test specimen. Subsequently, the 5772 sealant was applied in the above-mentioned fashion, and the nipple inserted into the coupling and started by hand. A torque wrench set to approximately 6 ft-lbs, simulating a hand-tight condition, was then used to tighten hex stock welded to the nipple, thus driving the nipple into the coupling until the torque wrench indicated that the desired degree of tightness had been achieved. (See Figure 3)

The torque wrench was then replaced with a break-over bar and socket, and the nipple tightened an additional 90˚ or 180˚, depending upon the test parameters for that specimen. (An additional quarter-turn (90˚) past hand tight (6 ft-lbs.) represents an approximate

Figure 4
Correct Seal Bead Formation Post-

torque of 20 ft-lbs.) Those test specimens initially tightened to a hand-tight plus 180˚ condition were backed off (loosened) 90˚ after one hour of initial assembly. Thus, all test specimens – regardless of other test conditions – were all tested at the same tightness equivalent to approximately 20 ft-lbs of torque on the nipple.

On assembly, this practice resulted in a nice even bead formation of sealant 360˚ around the nipple and coupling opening, without apparent excess sealant used. (See Figure 4) On disassembly, this method also showed that sealant had completed filled the gap in the thread form from the beginning point on the nipple to the exterior opening of the coupling.

Short-Term Screening Test

The test plan provided for a preliminary, short-term screening test – using compressed nitrogen gas as the contained fluid – to establish (i) whether 5772 could effectively seal a stainless-to-stainless steel or stainless-to-carbon steel threaded connection with a cure time of only six (6) hours, and (ii) to determine whether the sealant could accommodate adjustment the fitting after a one hour cure time, and (iii) to what extent an oil film on the threads to be sealed plays a role in sealing.

In this test, six (6) test specimens were prepared as follows:

Table 1
Short-Term Screening Specimen Conditions

Specimen	1	2	3	4	5	6
Grit-Blasted Threads	✓	✓	✓	✓	✓	✓
Oiled Threads					✓	✓
Handtight + 90˚	✓	✓				
Handtight + 180˚ - 90˚			✓	✓	✓	✓

Figure 5 shows the test fixture used to perform the short term screening test.

Figure 5
Short Term Screening Test Fixture

The samples were prepared, allowed to cure, and placed in a test fixture. Specimens 3-6 were initially assembled hand-tight plus 180˚ additional rotation, then backed off 90˚after completing the first hour of cure time. The 'handtight plus 90˚ with oiled threads' condition was not included as a test configuration. The Loctite representative suggested that the backing off action by 90˚ one hour after initial assembly was thought to be the controlling leakage factor, so it was decided to only test to what extent oiled threads might further exacerbate leakage in that configuration.

After a total of six hours cure time, all the specimens were pressurized in common using a pressurization line from a hand-loaded pressure regulator to a pressure of 100psi nitrogen, as indicated by individual gauges incorporated in the fixture for each specimen. After a two minute duration, allowed to provide time for any minor drop in pressure to occur caused by initial pressurization of the specimens, the specimen pressure was readjusted to 100psi and the block valves for each specimen were closed, thereby isolating each specimen.

The samples were then allowed to stand for a 24-hour evaluation period before reading the pressure drop occurring for each specimen. A second pressure reading was taken after five (5) days, in order to confirm the results of the initial 24-hour observation.

Long-Term Performance Test

The test plan also provided for a long-term performance test to determine whether extended exposure to the various fluids identified in Section 2.1 might have an adverse effect upon 5772 sealability in stainless-to-stainless steel or stainless-to-carbon steel threaded connections at temperature, over time.

In this test, eight (8) specimens were also prepared in the above fashion, with all joints initially assembled to 90˚ past a handtight condition (~20 ft-lbs total torque). No backing off of the pipe nipple was conducted post initial assembly. Both the male and female threads of the stainless components were sprayed lightly with a coating of Primer 7649 and allowed to air dry for 1-2 minutes before receiving an application of 5772 on the male threads. The used carbon steel threads were grit-blasted to remove old thread sealant and other surface coatings, but were otherwise assembled untreated. The assembled specimens were allowed to cure at room temperature (~70˚F) for six (6) hours.

Two specimens were filled with each of the four test liquids; Mobil DTE Light, Mobil SHC 624, Fyrquel EHC fluid, and tap water. ATF red dye was mixed with each liquid prior to filling the specimens.

Figure 6
Long Term Test Environment Chamber

Each of the specimens was placed in a test fixture housed inside a simple insulated and heated environmental chamber constructed for this research. Two (2) thermostatically-controlled 500w strip heaters were mounted in opposing corners of the chamber, at same height as the finished elevation of the couplings used in each test specimen. This was done to assure that the temperature at the threaded coupling in each specimen would be in the same thermal layer as the thermostat/heater, even though the small size of the chamber probably limited the degree to which any significant temperature stratification could occur. Two heaters were used to provide redundancy in the event of a heater failure during the test duration. For added assurance, a small 12vDC fan was inserted into the chamber to provide circulation within the chamber during the entire 30-day test duration. Chamber temperature was monitored using two independent temperature probes linked to a Hewlett-Packard temperature display unit. As with the heaters, two probes were used to provide redundancy, and positioned in opposing corners of the chamber at specimen coupling height.

In a trial prior to the actual test, the environmental chamber was assembled and brought up to temperature, which required approximately one hour to reach the desired target temperature of 150˚F. The thermostats were then adjusted until the chamber was able to maintain the desired test temperature. Subsequent periodic monitoring of the chamber temperature during the actual test duration indicated that this target temperature was maintained consistently within ±1.5˚F.

In order to accurately measure even minute leakage over a changing temperature range, the same method as used in the previous EPRI 2000 thread sealant testing was employed. This method consisted of pressurizing the test specimens in common to 100psi, then isolating them by means of a block valve for each specimen. All joints were initially 'snooped' for leakage using a solution of soapy water to generate bubbles wherever leakage was present.

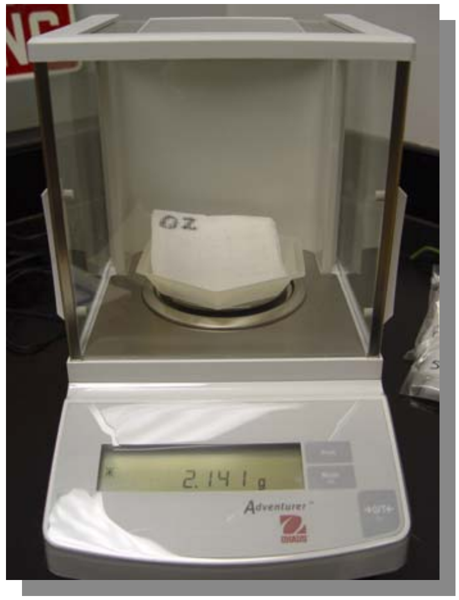

Figure 7
Weighing Absorbent Pads

After verifying that no gross leakage was evident in either the test specimens or the test fixture joints, individual pre-weighed and labeled white cotton gauze pads were carefully rolled around both the stainless-to-stainless and stainless-to-carbon steel joint of each specimen, and held in contact over the threaded joint using a rubber band. The gauze pads had been initially removed from their sterile wrappers, labeled using a black marker, and weighed to an accuracy of ±0.001gm. (See Figure 7) Each pad's weight and label number was recorded for documentation purposes. The weighed and marked pads were then reinserted into their sterile wrappers until it was time to remove them for application on a test specimen.

A gauze pad was used for the stainless-to-stainless steel joint, and another for the stainless-to-carbon steel joint, on each test specimen. This was done to eliminate any confusion over which joint might have leaked, and to what degree, during the test. Leakage would be determined by reweighing the test samples showing evidence of leakage at the completion of the test, as indicated by the visible presence of any AFT red dye used in the liquids, and comparing that weight to the originally recorded weight for that gauze pad. While not perfectly accurate, this simple means of evaluation will provide an adequate indication of relative leaktightness for each threaded joint, and has the added benefit of being able to indicate even minute weepage of oils from the joint.

3
TEST RESULTS

Following are the results of the short and long term tests.

Short-Term Test Results

The short term tests were actually conducted twice. On the first attempt, an existing bottle of Loctite Primer NF (the predecessor to 7649) was used. This bottle of primer was from the original supply used to perform the original EPRI thread sealant tests in 2000. Following are the results of that test.

Table 2
Short Term Test Results (Failed Primer)

	GB HT +90˚ -0˚		GB HT +180˚ -90˚		OIL HT +180˚ -90˚	
Initial Pressure	100	100	100	100	100	100
>1hr	97	100	31	79	100	95
% of Total	97%	100%	31%	79%	100%	95%
>5d	77	100	2	2	99	21
% of Total	77%	100%	2%	2%	99%	21%

As the above test shows, there was no clear indication of consistent performance achieved. Only one of the two specimens (col. 1&2) that were assembled with a clean (grit-blasted finish) to a hand-tight condition plus 90˚ rotation, and not subsequently backed off after one hour, sealed reliably. Specimens (col. 3&4) with clean threads that were initially tightened hand-tight plus 180˚ added rotation, and then backed off 90˚ after one hour, failed miserably. And finally, specimens (col. 5&6) that were assembled with oily threads instead of clean threats, then tightened 180˚ past hand-tight, then backed off 90˚ after one hour, provided very mixed results. It should be noted that all the leaks appeared to be from the stainless-to-stainless threaded connections.

Due to the illogical results in the above attempt, EPRI invited a Loctite technical representative to come to EPRI-Charlotte to review the above data, test methodology, specimen preparation, and second attempt to conduct the short-term testing. Upon review, the Loctite representative identified that the primer used (Primer NF) was very old stock and had actually been manufactured in 1998. It was his opinion that use of the current Loctite-recommended primer (7649) should resolve the continuity issue with respect to results achieved. The following table shows the results of the second attempt, incorporating this guidance and using new Loctite 7649 primer supplied by the Loctite representative.

Table 3
Short Term Test Results (New 7649 Primer)

	GB HT +90˚ -0˚		GB HT +180˚ -90˚		OIL HT +180˚ -90˚	
Initial Pressure	100	100	100	100	100	100
>1hr	100	100	100	100	100	100
% of Total	100%	100%	100%	100%	100%	100%
>5d	100	100	50	50	61	2
% of Total	100%	100%	50%	50%	61%	2%

After changing to the new, fresh Loctite 7649 primer, the results correlated much better. Table 3 clearly shows that where clean pipe threads are assembled and left undisturbed after assembly, even though the connection itself is relatively loosely assembled, (col. 1&2) the threaded connections are subject to be leaktight. Where the joint is assembled, and then backed off 90˚ one hour after initial assembly (col. 3-6), the joints are prone to leakage, and where the threads are coated with oil on assembly, the rate of leakage can vary.

The above results of the second test shown in Table 3 are important, because they clearly show that when leakage occurs, it may be so slight as to be initially undetectable.

Thus, it might be possible for the joint to appear to pass a post-maintenance inspection performed shortly after joint system pressurization, yet for some very small leakage to occur over time. While this type of leakage profile is not indicative of a catastrophic leak leading to rapid system depressurization or significant loss of product, it is perfectly suited to contributing to the general housekeeping issue that such leaks in lube oil systems particularly cause in many types of plants.

However, more important to the goals and objectives for this project, the data in Table 3 clearly suggest that it is possible to assemble stainless-to-stainless and stainless-to-carbon steel pipe threads using Loctite 5772 and Primer 7649, such that the joints are leaktight *when the pipe thread areas are properly cleaned, primed, assembled, and left undisturbed after initial assembly*.

Figure 8
Results of Long Term Multi-Fluid Test at 150˚F

Long-Term Test Results

The long term test ran for a duration of thirty (30) days, at a constant temperature of 150˚F. During this time, the environmental chamber was opened briefly after two weeks, to determine to what extent any leakage had occurred. During this inspection, no leakage whatsoever was observed on any of the test specimens.

At the end of the thirty day test, the cover of the environmental chamber was once again removed, and the test specimens once again inspected for leakage. As shown in Figure 8, no leakage was evident on any of the sixteen (16) tested joints; either stainless-to-stainless or stainless-to-carbon steel. (Circulation fan [black] shown in lower righthand corner of Figure 8)

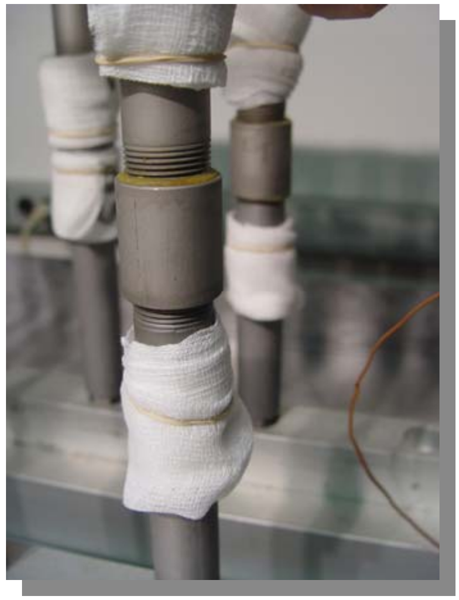

Figure 9
Closeup of Completed Long Term Test Coupling

The gauze pads on two specimens (far right) shown in Figure 8 were slid back to reveal the top and bottom threaded connections on each specimen for inspection of the seal bead itself. As shown in Figure 9, the 5772 seal bead appeared in very good condition, with no evidence of leakage whatsoever, confirming the absence of red dye on the gauze pads. All of the gauze pads were subsequently removed for inspection. No reweighing of the pads was necessary, as none showed any indication of leakage. Accordingly, no follow-on data analysis was necessary for the long term test.

5772 Cure Curve Data

In addition to the data and information generated by this EPRI research project, other valuable data is also available from the vendor, Henkel Loctite. Among the most important vendor-supplied information is data pertaining to the cure curve for Loctite 5772. Cure curves represent aspects of the change from fluid to solid that occurs in the sealant over time, including its ability to adhere to or bond onto engaged thread forms.

When reviewing the manufacturer's technical data sheet for Loctite 5772, the reviewer will note that no cure curve data is presented. Most other Loctite thread sealant technical data sheets include cure curve data for the product. Upon investigating the cure curves for 5772, EPRI learned from Loctite that the cure curve data for 5772 is essentially the same as the product from which 5772 was developed, Loctite 577. Accordingly, Loctite recommends that the following cure curves taken from the technical data sheet for Loctite 577 should be regarded as representative of that data for Loctite 5772.

Cure Speed vs. Substrate Material

Depending upon the reactivity of the substrate material, the rate at which 5772 cures to form a leaktight bond differs from one material to another. The cure curve shown in Figure 10 illustrates the relative speed with which 5772 cures for brass, (carbon) steel, zinc dichromate, and stainless steel.

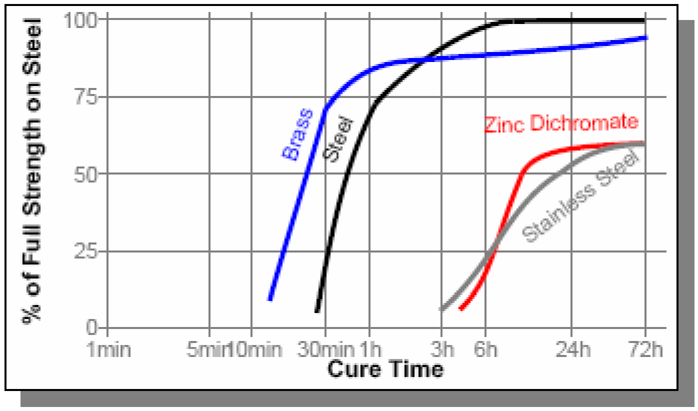

Figure 10
Cure Speed vs. Substrate Material

The data presented in this chart are natural values for materials without the use of any primers. As the graph shows, brass is the most reactive of the four metals shown. As an example, the chart shows that the thread sealant begins to cure after only fifteen (15) minutes, and reaches nearly 75% of its eventual strength within thirty (30) minutes. (NOTE: Loctite 5772 is an anaerobic compound, meaning it only begins to cure in the absence of oxygen, in practice, this means post-assembly.) The graph also shows that 5772 is capable of reaching 95% of its potential strength when used on brass material; an event that is reached approximately 72 hours after initial assembly. Likewise, when used on carbon steel, 5772 also begins to cure very quickly; about 25 minutes after initial assembly. However, on carbon steel, 5772 is capable of reaching 100% of its potential strength in a much shorter period (8 hours) of time.

However, when used on stainless steel, the curing process does not really begin until approximately three (3) hours after initial assembly of the joint, and never reaches more than 60% of its potential strength, and requires at least 48 hours to do so. For this reason, a primer is necessary to make the stainless steel surface more chemically reactive with respect to the 5772 compound.

Cure Speed Using Primers

Figure 11 illustrates a cure curve for zinc dichromate, which has a similar cure curve to stainless steel, relative to onset of curing and final strength. As the graph shows, use Primer 7649 causes curing of 5772 to begin in as little as ten (10) minutes after initial assembly, with the cure process complete after only thirty (30) minutes.

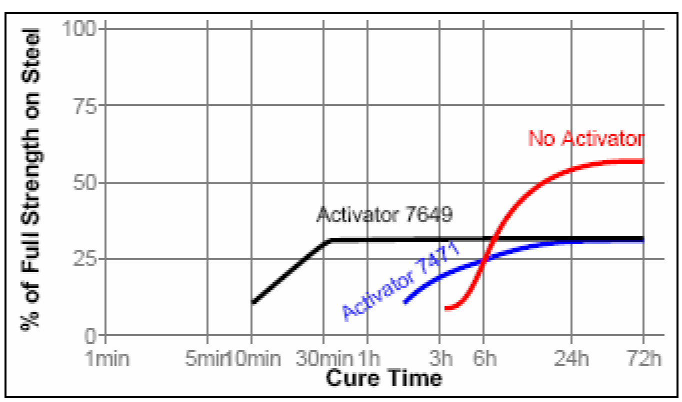

Figure 11
Cure Curves for Non-Reactive Metals Using Primers

Thus, when using Primer 7649, it is reasonable to assume that curing can be complete on stainless steel in as little as thirty (30) minutes as well. The obvious downside is that the potential strength of the bond is reduced by half, to around 30% instead of 60% when allowed to cure naturally over time. (NOTE: No attempt has been made by EPRI to quantify the strength requirements for 5772 used in different applications, such with primer vs. without primer. Upon review of the vendor information, 'potential strength' appears to be measured as a function of breakaway torque required to loosen a pipe from its fitting. It is unclear whether – or to what extent – this measure has any bearing whatsoever on the leaktightness of the joint.)

It is further worth noting that – according to the vendor data – use of a different primer, such as Loctite 7471, can delay initial curing for up to two (2) hours after assembly, creating a longer period with which to adjust the piping should any adjustment be necessary, without any loss of strength (as compared to use of Loctite Primer 7649). However, the vendor data suggests that it will require approximately eighteen (18) hours to achieve that relative strength, as opposed to only thirty (30) minutes when using 7649.

None the less, this knowledge surrounding use and choice of primers to adjust cure times and working times for piping components should prove valuable in selecting the appropriate primer to complement other assembly considerations for the particular application.

Other Vendor Cure Curve Data

The vendor technical data sheet for Loctite 577 also provides additional information – outside the scope of this report – on cure curves applicable to Loctite 5772 pertaining to cure speed vs. temperature, cure speed vs. bond gap, heat strength, and heat aging.

4 SUMMARY

The key finding of this research is that Loctite 5772 will effectively seal both stainless-to-stainless and stainless-to-carbon steel threaded joints with only six (6) hours of cure time when:

- Properly applied to clean pipe threads using a compatible primer [activator]
- Assembled with at least a minimum effort (~20 ft-lbs. torque) towards achieving tight mechanical engagement of the pipe and fitting, and
- Adjustment to the pipe is avoided after ten (10) minutes post initial assembly.

In addition, other important highlights include:

- Primer 7649 will reduce the initial cure time on stainless steel threads from three (3) hours to around fifteen (15) minutes, and reduce the overall cure time from seventy-two (72) hours to thirty (30) minutes.
- Primer 7471 will extend the workable time to adjust the piping up to two (2) hours before initial curing begins to take place (as compared to 7649).
- Not using any primer at all on stainless steel threads will require at least 48-72 hours for full curing to take place, but will double the effective strength of the sealant. (As previously noted, it is unclear to what extent breakaway strength of the sealant relates to leaktightness.)
- Adjusting the pipe in the fitting, after initial curing has begun to occur, appears to be the single biggest factor in determining the potential for subsequent fitting leakage.
- Properly orienting and engaging the thread sealant applicator to the threads, in order to inject the thread sealant down into the thread form, is important to achieving good distribution of sealant within the joint.
- Improperly assembled stainless-to-stainless joints may leak so minutely that they will pass a routine post-maintenance leaktightness test using a soap solution to test for bubble formation.

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