# XRT Stud and Grouting Installation Specification

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Date: 1/15/09

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Signature  
Date: 1/15/09

**Brief Summary:**  
Installation instructions for XRT (X-ray Tunnel) stands installed in the X-ray Transport Hall.

## Change History Log

<table>
<thead>
<tr>
<th>Rev Number</th>
<th>Revision Date</th>
<th>Sections Affected</th>
<th>Description of Change</th>
<th>By</th>
</tr>
</thead>
<tbody>
<tr>
<td>000</td>
<td></td>
<td>All</td>
<td>Initial Version</td>
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</tbody>
</table>
Summary

This document is intended as a guideline for the installation and grouting of the stands in the X-ray Transport Hall region of the LCLS project. These stands make up the majority of beam line and instrument supports between Hutch 3 and Hutch 4. This document applies to all of the Floor Anchor Install and Grouting and Stand Install drawings in the ID-391-030-XXX series. All dimensions will be in the LCLS coordinate system and/or be locally referenced to an LCLS described point.

Anchor Installation

Floor Marking

The floor will be marked using the templates specified in the FLOOR ANCHOR INSTL drawings (ID-391-030-XXX series). Align the templates using the dimensions given in these drawings and mark the floor through the four (4) corner holes with spray paint, marking the drill locations for the anchors.

Drilling and Installation

Anchors (PF-380-736-25) will be installed with Hilti HIT-RE-500-SD adhesive into the concrete floor. For complete anchor installation specifications consult ICC report ESR-2322 (available through the Hilti website):


The ICC specification supersedes this document, but generally:

- 7/8” diameter holes 7.25” depth are to be drilled using a rotohammer with a carbide tipped drill bit complying with ANSI B212.15-1994. In instances when rebar impedes drilling, a core drill will be used to drill through the rebar. A matched tolerance diamond core bit using a diamond core machine as specified by Hilti will be used in this instance. The remainder of the hole to be completed using an appropriate carbide bit.
- Holes must be cleaned of dust and debris by blowing with oil free compressed air, brushing three times with a wire brush, and blowing again with compressed air to achieve a relatively dust free wall surface.
- Perform special inspection of prepped holes as required by ESR-2322 section titled “Instructions For Use”, recording all relevant data for SLAC UTR.
- Holes may be dry or damp but must not contain any water at the time of anchor installation.
- Vendor will use HILTI HIT Profri accessory set Part Number 385231 and Piston Part Number 274024 for HIT-RE-500-SD adhesive.
- Check expiration date on HIT-RE-500-SD adhesive pack, attach injection nozzle with internal mixing element, and put into dispenser.
- First two (2) trigger pulls from each new injection nozzle must be discarded to ensure proper mixing.
- Holes must be filled approximately 2/3 full, filling from the bottom to the top.
- Anchor (PF-380-736-25) is to be twisted in a clockwise direction as it is inserted into the hole (to minimize air pockets). 6.75” of the anchor is to be embedded (anchor is marked). A
steel flat washer and ¼-10 hex nut will suspend the anchor at the 6.75" insertion depth. The washer will remain in place after cure, but the ¼-10 hex nuts will be removed after cure.

- Anchor position may only be adjusted during the gel time, which is approximately 30 minutes at 68°F. The anchor reaches full cure in 6 hours (at 68°F). Do not disturb between gel time and cure time. For other temperatures see ESR-2322.

Stand and Alignment Plate Installation

After full anchor cure time, the Alignment Plates and Stands (those not requiring an alignment plate) may be installed. Align using the tooling ball sockets and the dimensions given in the GROUTING & STAND INSTALL drawings (also in the ID-391-030-XXX series). The dimensions given are from the nearest device center to the top center of each tooling ball socket. See Figures 1 & 2 below for details on hardware.

Installing Stands

After full anchor cure time, install the Alignment plate. After the Alignment plate is installed and aligned, torque the ¼-10 hex nuts to 130 ft.-lbs.

DO NOT USE AN IMPACT WRENCH.

The SLAC UTR will approve grouting after stand installation and alignment.

The gap between the plate or stand base and floor will then be filled with BASF MasterFlow see (Figure 1). The grout will have no visible external gaps. There will be minimal air inclusions in the interior (non-visible) grout volume (less than 2% by volume). The existing floor must be roughed prior to setting the grout.

When grout has cured the stands will be installed. Remove the socket head cap screws (which were used as plugs) from the Alignment plate. Set the stand on the alignment dowels in the alignment plate. Install the threaded stud, washer, and nut as shown in Figure 1. The nuts will be torqued to 130 ft.-lbs. The SLAC UTR will approve the installation of each stand after final fastener torque.

Figure 1 Grout and Hardware with Alignment Plate
Installing Component and Drift Stands

After full anchor cure time, install a washer and 3/4-10 nut on each anchor. Set each component or drift stand on the anchor quartet. Align the stand. Install a washer nut set on each anchor and torque to 130 ft-lbs after alignment.

DO NOT USE AN IMPACT WRENCH.

The SLAC UTR will approve grouting after stand installation and alignment.

After the Stand is installed, fill the gap between the floor and the stand base with BASF MasterFlow 928 as shown in Figure 2. The grout will have no visible external gaps. There will be minimal air inclusions in the interior (non-visible) grout volume (less than 2% by volume).

Figure 2: Grout and Hardware without Alignment Plate
Component and Drift Stands
Appendix

BASF MasterFlow 928 See MSDS.

A local source: D.M.Figley / Josh (650) 269-2851.
MASTERFLOW® 928
High-precision mineral-aggregate grout with extended working time

Description
Masterflow® 928 grout is a hydraulic cement-based mineral-aggregate grout with an extended working time. It is ideally suited for grouting machines or plates requiring precision load-bearing support. It can be placed from full to damp pack over a temperature range of 45 to 90°F (7 to 32°C). Masterflow® 928 grout meets the requirements of ASTM C 1197, Grades B and C, the Army Corp of Engineers' CEM C 621, Grades B and C at a fluid consistency over a 30 minute working time and ANSI/NSF 61 approved. Suitable for use with potable water.

Yield
One 55 lb (25 kg) bag of Masterflow® 928 grout, mixed with approximately 10.5 lbs (4.8 kg) or 1.26 gallons (4.7 L) of water, yields approximately 0.60 ft³ (0.014 m³) of grout.

The water requirement may vary due to mixing efficiency, temperature, and other variables.

Packaging
55 lb (25 kg) multi-wall paper bags, 3,300 lb (1,500 kg) bulk bags

Shelf Life
1 year when properly stored

Storage
Store in unopened bags in clean, dry conditions.

Features
- Extended working time
- Can be mixed at a wide range of consistencies
- Freeze/thaw resistant
- Hardens free of bleeding, segregation, or settlement shrinkage
- Contains high-quality, well-graded aggregate
- Sulfate resistant
- ANSI/NSF 61 approved

Benefits
- Ensures efficient time for placement
- Ensures proper placement under a variety of conditions
- Suitable for interior applications
- Provides a maximum effective bearing area for optimum load transfer
- Provides optimum strength and durability
- Suitable for use in potable water

Where to Use
APPLICATION
- Where a nonshrink grout is required for maximum effective bearing area for optimum load transfer
- Where high one-day and later-age compressive strengths are required
- Nonshrink grouting of machinery and equipment, baseplates, sumps, piers, wall panels, beams, columns; curtain walls, concrete systems, other structural and nonstructural building members; anchor bolts, reinforcing bars, and dowel rods
- Applications requiring a pumpable grout
- Repairing concrete, including grouting voids and rock pockets
- Marine applications
- Freeze/thaw environments

LOCATION
- Interior or exterior

How to Apply
Surface Preparation
1. Steel surfaces must be free of dirt, oil, grease, or other contaminants.
2. The surface to be grouted must be clear, SSD, smooth, and roughened to a TSP of 5 – 9 following ICR Guideline 03732 to permit proper bond. For freshly placed concrete, consider using Liquid Surface Etchant (see Form No. 1020198) to achieve the required surface profile.
3. When dynamic, shear or tensile forces are anticipated, concrete surfaces should be chipped with a "chisel-point" hammer, to a roughness of (plus or minus) 3/8" (10 mm). Verify the absence of moisture following ICR Guideline 03732.
4. Concrete surfaces should be saturated (soaked) with clean water for 24 hours just before grouting.
5. All freelancing water must be removed from the foundation and bolt holes immediately before grouting.
6. Anchor bolt holes must be grouted and sufficiently set before the major portion of the grout is placed.
7. Sheds the foundation from sunlight 24 hours before and 24 hours after grouting.
Technical Data

Composition
Masterflow® 028 is a hydraulic cement-based mineral-aggregate grout.

Conformances
- ASTM C 1107, Grades B and C, and CRO 621, Grades B and C, requirements at a fluid consistency over a temperature range of 40 to 96°F (4 to 32°C).
- City of Los Angeles Research Report Number AR 23137
- ANSI / NSF 61 for use with potable water

| Test Data | ASTM C 042, according to ASTM C 1107 |

**Compressive strengths, psi (MPa)**

<table>
<thead>
<tr>
<th></th>
<th>Plastic¹</th>
<th>Flowable²</th>
<th>Fluid³</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 day</td>
<td>4,300 (31)</td>
<td>4,000 (28)</td>
<td>3,500 (24)</td>
</tr>
<tr>
<td>3 days</td>
<td>6,000 (41)</td>
<td>5,000 (34)</td>
<td>4,500 (31)</td>
</tr>
<tr>
<td>7 days</td>
<td>7,500 (52)</td>
<td>6,700 (48)</td>
<td>6,000 (43)</td>
</tr>
<tr>
<td>28 days</td>
<td>9,000 (62)</td>
<td>8,000 (68)</td>
<td>7,500 (62)</td>
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**Volume change**

<table>
<thead>
<tr>
<th></th>
<th>% Change</th>
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<tbody>
<tr>
<td>1 day</td>
<td>&gt; 3</td>
</tr>
<tr>
<td>3 days</td>
<td>0.04</td>
</tr>
<tr>
<td>14 days</td>
<td>0.03</td>
</tr>
<tr>
<td>28 days</td>
<td>0.00</td>
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</table>

**Setting time, hr:min**

<table>
<thead>
<tr>
<th></th>
<th>ASTM C 191</th>
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<tbody>
<tr>
<td>Initial set</td>
<td>Plastic¹</td>
</tr>
<tr>
<td>Final set</td>
<td>Plastic¹</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Plastic¹</th>
<th>Flowable²</th>
<th>Fluid³</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 days</td>
<td>1,000 (69)</td>
<td>1,000 (72)</td>
<td>1,100 (73)</td>
</tr>
<tr>
<td>7 days</td>
<td>1,000 (72)</td>
<td>1,000 (72)</td>
<td>1,100 (73)</td>
</tr>
<tr>
<td>28 days</td>
<td>1,000 (73)</td>
<td>1,000 (73)</td>
<td>1,100 (73)</td>
</tr>
</tbody>
</table>

**Modulus of elasticity, psi (MPa)**

<table>
<thead>
<tr>
<th></th>
<th>ASTM C 462, modified</th>
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<tbody>
<tr>
<td>3 days</td>
<td>2.82 x 10⁶ (1.94 x 10³)</td>
</tr>
<tr>
<td>7 days</td>
<td>3.02 x 10⁶ (2.08 x 10³)</td>
</tr>
<tr>
<td>28 days</td>
<td>3.24 x 10⁶ (2.39 x 10³)</td>
</tr>
</tbody>
</table>

**Coefficient of thermal expansion,°F/°F (mm/m) °C**

<table>
<thead>
<tr>
<th></th>
<th>ASTM C 531</th>
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</thead>
<tbody>
<tr>
<td>6.5 x 10⁻⁶ (11.7 x 10⁻¹)</td>
<td></td>
</tr>
</tbody>
</table>

**Split tensile and tensile strength, psi (MPa)**

<table>
<thead>
<tr>
<th></th>
<th>ASTM C 496 (splitting tensile)</th>
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<tbody>
<tr>
<td>3 days</td>
<td>5/16 (0.0) 460 (3.4)</td>
</tr>
<tr>
<td>7 days</td>
<td>5/16 (0.0) 460 (3.4)</td>
</tr>
<tr>
<td>28 days</td>
<td>6/8 (0.15) 500 (3.4)</td>
</tr>
</tbody>
</table>

**Bending stress strength, psi (MPa)**

<table>
<thead>
<tr>
<th></th>
<th>ASTM C 636</th>
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</thead>
<tbody>
<tr>
<td>3 by 3 by 11” (76 by 76 by 279 mm) beam</td>
<td></td>
</tr>
<tr>
<td>3 days</td>
<td>2,200 (15.2)</td>
</tr>
<tr>
<td>7 days</td>
<td>2,260 (15.6)</td>
</tr>
<tr>
<td>28 days</td>
<td>2,650 (18.2)</td>
</tr>
</tbody>
</table>

**Resistance to rapid freezing and thawing**

<table>
<thead>
<tr>
<th></th>
<th>ASTM C 666, Procedure A</th>
</tr>
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<tbody>
<tr>
<td>300 Cycles RPD 90%</td>
<td></td>
</tr>
</tbody>
</table>

¹100 - 120% flow on flow test per ASTM C 230
²125 - 140% flow on flow test per ASTM C 230
³25 to 30 seconds through cone per ASTM C 933

Test results are averages obtained under laboratory conditions. Expect reasonable variations.
Test Data, continued

Ultimate tensile strength and bond stress

<table>
<thead>
<tr>
<th>Diameter in (mm)</th>
<th>Depth in (mm)</th>
<th>Tensile strength (ksi)</th>
<th>Bond stress (psi)</th>
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</thead>
<tbody>
<tr>
<td>5/8 (15.9)</td>
<td>&lt;1 (11.1)</td>
<td>23,500 (161,570)</td>
<td>2,938 (20.3)</td>
</tr>
<tr>
<td>3/4 (19.0)</td>
<td>1 (127.0)</td>
<td>30,002 (207,060)</td>
<td>2,839 (19.9)</td>
</tr>
<tr>
<td>1 (25.4)</td>
<td>6.75 (171.5)</td>
<td>65,500 (452,775)</td>
<td>3,090 (21.3)</td>
</tr>
</tbody>
</table>

*Average of 5 tests in a 4X4.0 in. (271.6 MPA) concrete using 150 ft. (46 m) embedment, not in 2" (51 mm) diameter, sharp core drilled holes.

Notes:
1. Grouts was mixed to a fluid consistency.
2. Recommended design stress: 2,275 psi (16 MPa).
3. Refer to the "Adhesive and Sealed Fastener Capacity Design Guidelines" for more detailed information.
4. Tensile tests with bonded fasteners were performed by independent labs.

Jobsite Testing

If strength tests must be made at the jobsite, use 2" (51 mm) metal cube molds as specified by ASTM C 942 and ASTM C 1187. Do not use cylinder molds. Control field and laboratory tests on the basis of desired placement consistency rather than strictly on water content.

Forming

1. Forms should be liquid tight and nonabsorbent. Seal forms with puréed sealant, caulk, polyurethane foam.
2. Modern forms should utilize a hose form placed at 45 degree to enhance the grout placement. A moving hose form may provide additional head at minimum cost.
3. Side and end forms should be a minimum 1" (25 mm) distant horizontally from the object ground to permit expulsion of air and any remaining saturation water as the grout is placed.
4. Leave a minimum of 2" between the bearing plate and the form to allow for ease of placement.
5. Use sufficient bracing to prevent the grout from leaking or moving.
6. Eliminate large, unsupported grout areas wherever possible.
7. Extend forms a minimum of 1" (25 mm) higher than the bottom of the equipment being grouted.
8. Expansion joints may be necessary for both indoor and outdoor installations. Consult your local BASF field representative for suggestions and recommendations.

Temperature

1. For precision grouting, store and mix grout to produce the desired mixed-grout temperature. If bagged material is hot, use cold water, and if bagged material is cold, use warm water to achieve a mixed-product temperature as close to 70°F (21°C) as possible.

<table>
<thead>
<tr>
<th>Recommended Temperature Guidelines for Precision Grouting</th>
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<tbody>
<tr>
<td>Foundation and plate</td>
</tr>
<tr>
<td>Mixing water</td>
</tr>
<tr>
<td>Great at mix</td>
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<tr>
<td>And placed temp</td>
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2. If temperature extremes are anticipated or special placement procedures are planned, consult your local BASF field representative for assistance.
3. When grouting at minimum temperatures, see that the foundation, plate, and grout temperatures do not fall below 40°F (4°C) until after final set. Protect the grout from freezing (32°F or 0°C) until it has attained a compressive strength of 3,000 psi (21 MPa).

Mixing

1. Place estimated water (use potable water only) into the mixer, then slowly add the grout. For a fluid consistency, start with 0.84 ft. (4.0 kg) of water per 56 lb. bag.
2. The water demand will depend on mixing efficiency, material, and ambient-temperature conditions. Adjust the water to achieve the desired flow. Recommended flow is 25 - 30 seconds using the ASTM C 939 Flow-Cone Method. Use the minimum amount of water required to achieve the necessary placement consistency.
3. Moderately sized batches of grout are best mixed in one or more clean mortar mixers. For large batches, use ready-mix trucks and 3,000 lb. (1,500 kg) bags for minimum efficiency and economy.
4. Mix grout a minimum of 5 minutes after all material and water is in the mixer. Use mechanical mixer only.
5. Do not mix more grout than can be placed in approximately 30 minutes.
6. Transport by wheelbarrow or bucket or pump to the equipment being grouted. Minimize the transporting distance.
7. Do not temper grout by adding water and remixing or allowing to stiffen.
8. Do not klodge grout to facilitate placement.
For aggregate extension guidelines, refer to Appendix M8-10: Guide to Cementitious Grouting.

Application

1. Always place grout from only one side of the equipment to prevent air or water entrapment beneath the equipment. Place Masterflow® 928 in a continuous pour. Discard grout that becomes unserviceable. Make sure that the material fills the entire space being grouted and that it remains in contact with plates throughout the grouting process.

2. Immediately after placement, trim the surface with a trowel and cover the exposed grout with clean wet rags (not burlaps). Keep rags moist until grout surface is ready for finishing or until final set.

3. The grout should offer still resistance to penetration with a pointed Mason's trowel before the grout frames are removed or excess grout is cut back. After removing the slump rags, immediately coat with a recommended curing compound with ASTM C 939 or preferably ASTM C 1231.

4. Do not add grout to concrete slabs or free beds of gravel under the slab to help increase the grout.

5. Consult your BASF representative before placing tiles more than 6" (152 mm) in depth.

Curing

Cure all exposed grout with an approved membrane curing compound compliant with ASTM C 305 or preferably ASTM C 1231. Apply curing compound immediately after the wet rags are removed to minimize potential moisture loss.

For Best Performance

- For guidelines on specific anchor-bolt applications, contact BASF Technical Service.
- Do not use fillers, accelerators, retarders, or other additives unless advised in writing by BASF Technical Service.
- The water requirement may vary with mixing efficiency, temperature, and other variables.
- Hold a pre-job conference with your local representative to plan the installation. Hold conferences as early as possible before the installation of equipment, valve plates, or rail mounts. Conferences are important for applying the recommendations in this product data sheet to a given project, and they help ensure a placement of highest quality and lowest cost.
- The ambient and initial temperature of the grout should be in the range of 45 to 97°F (7 to 36°C) for both mixing and placing. Ideally, the amount of mixing water used should be that which is necessary to achieve a 25 - 30 second flow according to ASTM C 939 (C 939-85A).

Risks

Product is alkaline in contact with water and may cause injury to skin or eyes. McGovern or inhalation of dust may cause irritation. Contains small amount of free respirable quartz which has been listed as a suspected human carcinogen by NTP and IARC. Repeated or prolonged exposure to free respirable quartz may cause silicosis or other serious and delayed lung injury.

Precautions

Avoid contact with skin, eyes and clothing. Prevent inhalation of dust. Wash thoroughly after handling. Keep container closed when not in use. DO NOT take internally. Use only with adequate ventilation. Use imperious gloves, eye protection and if the TVL is exceeded or used in an enclosed or poorly ventilated area, use NIOSH/MSHA approved respiratory protection in accordance with applicable federal, state, and local regulations.

First Aid

In case of eye contact, flush thoroughly with water for at least 15 minutes. In case of skin contact, wash affected areas with soap and water. If irritation persists, SEEK MEDICAL ATTENTION. Remove and wash contaminated clothing. If inhalation causes physical discomfort, remove to fresh air. If discomfort persists or any breathing difficulty occurs or if swallowed, SEEK IMMEDIATE MEDICAL ATTENTION.

Waste Disposal Method

This product when discarded or disposed of, is not listed as a hazardous waste in federal regulations. Dispose of in a landfill in accordance with local regulations. For additional information or personal protective equipment, first aid, and emergency procedures, refer to the product Material Safety Data Sheet (MSDS) on the job site or contact the company at the address or phone numbers given below.

Provision 85

This product contains material listed by the State of California as known to cause cancer, birth defects or other reproductive harm.

VOC Content

0 g/l or 0 lbs/gal less water and exempt solvents.

For medical emergencies only, call ChemTrec (1-800-424-9300).

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Technical Service 609-243-5739

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