HILTI F-BT

Visual Examination Catalogue

CONTENTS

HILTI F-BT VISUAL EXAMINATION CATALOGUE

The visual examination and assessment for Hilti F-BT studs is split in two parts.

First, the examination of the surface preparation (Table 2 and Table 3) prior to welding and second, the examination for the F-BT stud welding itself (Table 4 and Table 5).

The purpose of the examination catalogue is to assess the visual appearance as acceptable or not acceptable for use.

The criteria for the appearance of the stud are complementary to the requirements of EN ISO 14555:2017 Table A.5 and AWS D1.6 Clause 9.7. Using these standards as a basis, this document addresses the specifics of the Hilti F-BT welded studs.

The examination catalogue for the surface preparation is exclusively established for the appearance of preparations completed using the Hilti FX 3-ST surface tools.

The Hilti F-BT examination catalogue shall be used for the welding procedure qualification record (WPQR/PQR) as well as for stud examination during process control, production welding control and production surveillance.

Table 1 provides explanation how to read the schematic sketches used in this catalogue.

Table 1: Schematics explanation

Schematic	Explanation
Surface preparation examination	
	Top-down view of a surface preparation on coated steel. The coating colour is red in this example. In both schematics an outer ring is shown. The left schematic shows a "shiny ring" on the outside. While the right schematic shows a ring that has residuals, which will be a more dull color. The small circle in the center of each schematic represents the indentation formed by the center tip of the surface tool.
Welded stud examination	
	Top-down view of an F-BT welded to the parent material prepared with FX 3-ST d20 surface tool.
	Top-down view of an F-BT welded to the parent material prepared with FX 3-ST d14 surface tool.

Table 2: Surface preparation of coated parent material with surface tool FX 3-ST d20

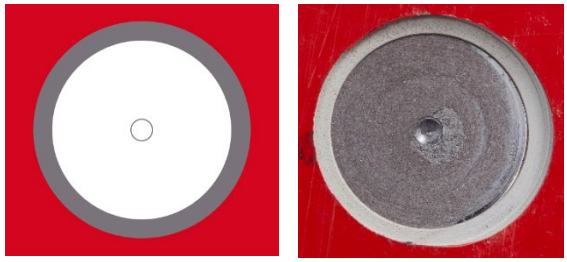
No	Schematics	Example images	Assessment	Recommended corrective action
1	**Blank and shiny ring**		**ACCEPTABLE**	None
2	**Residuals on the outer ring**		**NOT ACCEPTABLE:** Residuals on the outer ring.	Continue the preparation process until the stop shoulder (outer ring) is clean 360° around. Change the surface tool if needed.
3	**Inclined preparation surface**		**NOT ACCEPTABLE:** One sided residuals and inclined preparations.	Continue the preparation process and tilt the drilling machine slightly to the side, where residuals are found to remove them and provide an even surface for stud installation.
4	**Uneven preparation**		**NOT ACCEPTABLE:** Residuals on the surface.	Hold and press the tool straight to the surface when preparing the surface. Avoid wobbling of the surface tool.
5	**Unsymmetrical or doubled preparation**		**NOT ACCEPTABLE:** An unsymmetrical preparation showing a double circle.	Do not use unsymmetrical preparations for welding. Create a preparation at a new location. Next time hold and press the tool straight and firm during the preparation process.

Table 3: Surface preparation of uncoated parent material with surface tool FX 3-ST d14

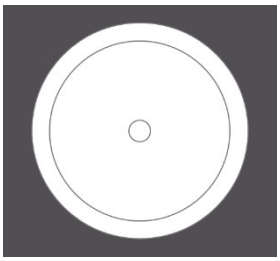
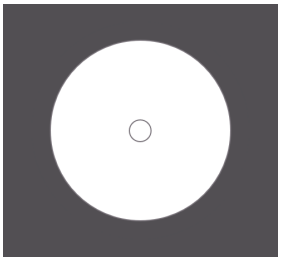
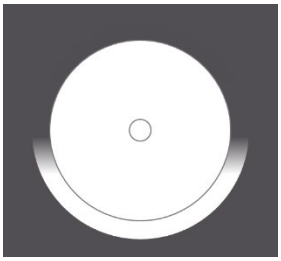
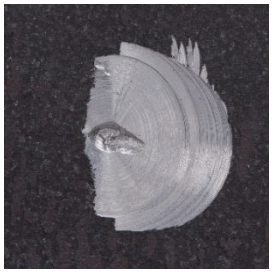
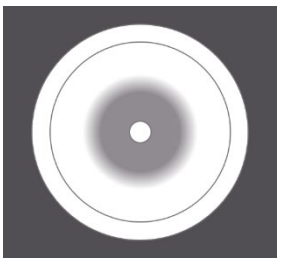
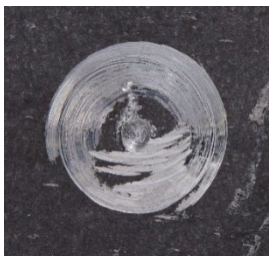
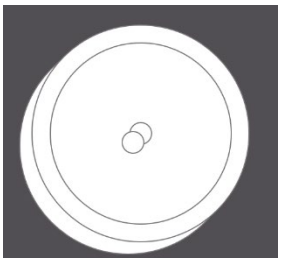
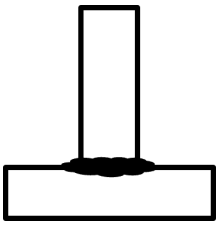
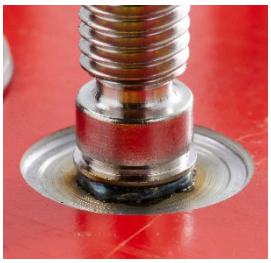
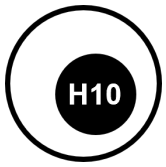
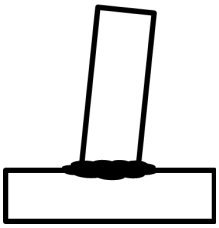
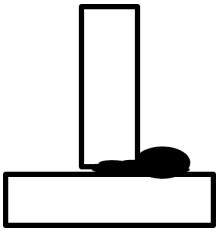
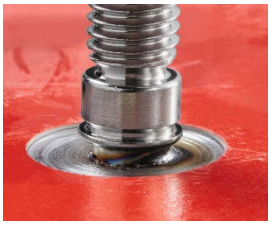
No	Schematics	Example images	Assessment	Recommended corrective action
1	**Blank and shiny ring** 		**ACCEPTABLE**	None
2	**Residuals on the outer ring** 		**NOT ACCEPTABLE:** Residuals on the ring.	Continue the preparation process until the stop shoulder (outer ring) is clean 360° around. Change the surface tool if needed.
3	**Inclined preparation surface** 		**NOT ACCEPTABLE:** One sided residuals and inclined preparations.	Continue the preparation process and tilt the drilling machine slightly to the side, where residuals are found to remove them and provide an even surface for stud installation.
4	**Uneven preparation** 		**NOT ACCEPTABLE:** Residuals on the surface.	Hold and press the tool straight to the surface when preparing the surface. Avoid wobbling of the surface tool.
5	**Unsymmetrical or doubled preparation** 		**NOT ACCEPTABLE:** An unsymmetrical or doubled preparation.	Do not use unsymmetrical preparations for welding. Create a preparation at a new location. Next time hold and press the tool straight and firm during the preparation process.

Table 4: Visual examination catalogue for F-BT studs welded on coated steel (surface tool FX 3-ST d20)

No	Schematics	Example images	Assessment	Recommended corrective action	Comple-mentary to
1	**Regular and complete collar** 		**ACCEPTABLE**	None.	Table A.5, No. 4 of EN ISO 14555:2017
2	**Eccentric stud** 		**NOT ACCEPTABLE:** Studs welded eccentric to the circular preparation. → **Remove and reinstall** stud	Center the tip of the stud in the middle of the surface preparation. Hold the hand tool FX 3-HT centered, perpendicular and calm.	Table A.5, No. 4 of EN ISO 14555:2017
3	**Inclined stud >2°** 		**NOT ACCEPTABLE:** Inclined studs >2°. → **Remove and reinstall** stud	Hold the hand tool perpendicular and firm during welding. Assure that the surface preparation is parallel to the parent material surface.	Table A.5, No. 4 of EN ISO 14555:2017
4	**One-sided connection, weld drop protruding** 		**NOT ACCEPTABLE:** One-sided weld connection. → **Test or remove** the welded stud	Comply with the surface preparation requirements in Table 2. Comply with base clamp, stud, and edge spacing requirements.	Table A.5, No. 4 of EN ISO 14555:2017 and Clause 9.7.1 of AWS D1.6/D1.6M: 2017

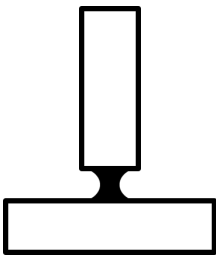
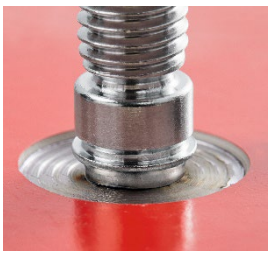
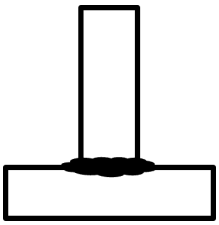
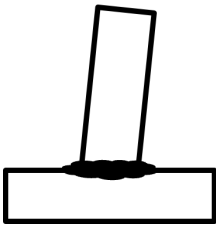
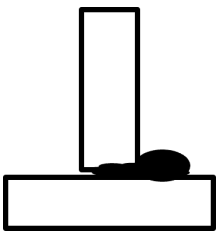
No	Schematics	Example images	Assessment	Recommended corrective action	Comple-mentary to
5	**Soot around the weld** 		**NOT ACCEPTABLE:** Studs with soot around the weld. → **Test or remove** the welded stud	Comply with the surface preparation requirements in Table 2. Make sure that the surface preparation and the stud are free of any contamination.	Table A.5, No. 3 and 4 of EN ISO 14555:2017
6	**Splatter or sparks** 		**NOT ACCEPTABLE:** Studs with splatter or sparks around the weld. → **Test or remove** the welded stud	Comply with the surface preparation requirements in Table 2. Make sure that the surface preparation and the stud are free of any contamination.	Table A.5, No. 3 and 5 of EN ISO 14555:2017 and Clause 9.7.1 of AWS D1.6/D1.6M: 2017
7	**Weld diameter reduced, unusual stand off** 		**NOT ACCEPTABLE:** Studs with reduced diameter or unusual high stand-off. → **Remove and reinstall** stud	Check Weld Code (H-Code) setting. Comply with surface preparation requirements in Table 2. Make sure that the surface preparation and the stud are free of any contamination.	Table A.5, No. 2 of EN ISO 14555:2017 and Clause 9.7.1 of AWS D1.6/D1.6M: 2017
8	**F-Code displayed on the tool** 		**NOT ACCEPTABLE:** Studs with F-Code displayed after the weld. → **Follow the actions required in** Table 6	Corrective actions depending on F-Code listed in Table 6.	

Table 5: Visual examination catalogue for F-BT studs welded on uncoated steel (surface tool FX 3-ST d14)

No	Schematics	Example images	Assessment	Recommended corrective action	Comple-mentary to
1	**Regular complete collar around the weld pin** 		**ACCEPTABLE**	None.	Table A.5, No. 4 of EN ISO 14555:2017
2	**Eccentric stud** 		**NOT ACCEPTABLE:** Studs welded eccentric to the circular preparation. → **Remove and reinstall** stud	Center the tip of the stud in the middle of the surface preparation. Hold the hand tool FX 3-HT centered, perpendicular and calm.	Table A.5, No. 4 of EN ISO 14555:2017
3	**Inclined stud >2°** 		**NOT ACCEPTABLE:** Inclined studs >2°. → **Remove and reinstall** stud	Hold the hand tool perpendicular and firm during welding. Assure that the surface preparation is parallel to the parent material surface.	Table A.5, No. 4 of EN ISO 14555:2017
4	**One-sided connection, weld drop protruding** 		**NOT ACCEPTABLE:** One-sided weld connection. → **Test or remove** the welded stud	Comply with the surface preparation requirements in Table 2. Comply with base clamp, stud, and edge spacing requirements.	Table A.5, No. 4 of EN ISO 14555:2017 and Clause 9.7.1 of AWS D1.6/D1.6M: 2017

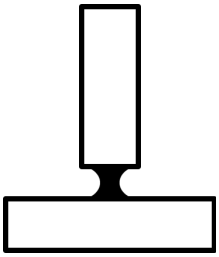
No	Schematics	Example images	Assessment	Recommended corrective action	Comple-mentary to
5	**Soot around the weld** 		**NOT ACCEPTABLE:** Studs with soot around the weld. → **Test or remove** the welded stud	Comply with the surface preparation requirements in Table 3. Make sure that the surface preparation and the stud are free of any contamination.	Table A.5, No. 3 and 4 of EN ISO 14555:2017
6	**Splatter or sparks** 		**NOT ACCEPTABLE:** Studs with splatter or sparks around the weld. → **Test or remove** the welded stud	Comply with the surface preparation requirements in Table 3. Make sure that the surface preparation and the stud are free of any contamination.	Table A.5, No. 3 and 5 of EN ISO 14555:2017 and Clause 9.7.1 of AWS D1.6/D1.6M: 2017
7	**Weld diameter reduced, unusual stand off** 		**NOT ACCEPTABLE:** Studs with reduced diameter or unusually high stand-off are. → **Remove and reinstall** stud	Check Weld Code setting. Comply with surface preparation requirements in Table 3. Make sure that the surface preparation and the stud are free of any contamination.	Table A.5, No. 2 of EN ISO 14555:2017 and Clause 9.7.1 of AWS D1.6/D1.6M: 2017
8	**F-Code displayed on the tool** 		**NOT ACCEPTABLE:** Studs with F-Code displayed after the weld. → **Follow the actions required in** Table 6	Corrective actions depending on F-Code listed in Table 6.	

Table 6: F-Code list, failure case requiring removal or inspection of stud

<table>
<tr><th>F-Code</th><th>Failure case</th><th>Required action</th></tr>
<tr><td>F06</td><td>Hand tool inner mechanics sticky</td><td rowspan="5">Either:
Test the stud to the tensile proof load with the HAT 28 FX. The proof load depends on the Weld Code (H-Code) of the stud. If the stud withstands the proof load, it is good to be used, else it shall be re-installed.
<table><tr><th>Weld code (H-Code)</th><th>Tensile proof load in kN (lbf)</th></tr><tr><td>H1</td><td>6 (1350)</td></tr><tr><td>H2</td><td>9 (2025)</td></tr><tr><td>H3</td><td>17 (3820)</td></tr><tr><td>H10</td><td>22 (4950)</td></tr></table>Or:
Remove and reinstall the stud directly without testing.</td></tr>
<tr><td>F07</td><td>Electrical connection bad</td></tr>
<tr><td>F10</td><td>Stud embedment not proper</td></tr>
<tr><td>F14</td><td>Operator interrupted process</td></tr>
<tr><td>F16</td><td>Spot contaminated</td></tr>
<tr><td>F17</td><td>Process aborted</td><td>Remove and reinstall the stud</td></tr>
</table>

- For corrective actions to avoid repeated occurrence of F-Codes see Sticker inside of the Kit box.
- For troubleshooting of F-Codes not listed here see Sticker inside of the Kit box.
- Recommendation on how to remove and reinstall F-BT can be found in the repair procedure for F-BT.

كتالوج الفحص البصري HILTI F-BT

ينقسم الفحص والتقييم البصري لمسامير Hilti F-BT إلى جزأين.

الجزء الأول، وهو فحص تحضير السطح (الجدول 2 والجدول 3) قبل اللحام، والجزء الثاني، فحص لحام مسمار F-BT نفسه (الجدول 4 والجدول 5).

الغرض من كتالوج الفحص هو تقييم الشكل الخارجي كمقبول أو غير مقبول للاستخدام.

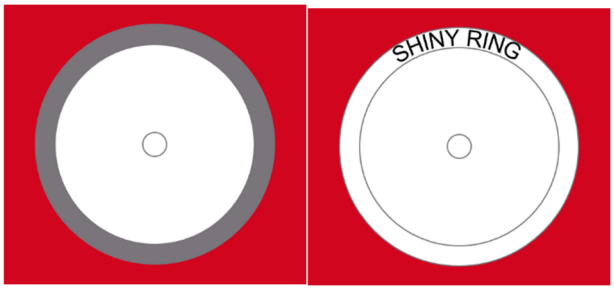
تتكامل معايير الشكل الخارجي للمسامير مع المتطلبات الواردة في الجدول A.5 لمعايير EN ISO 14555:2017 وكذلك الفقرة 9.7 من قانون D1.6 لجمعية اللحام الأمريكية (AWS). يتناول هذا المستند، معتمدًا على هذه المعايير كأساس، مواصفات مسامير Hilti F-BT الملحومة.

تم إنشاء كتالوج الفحص الخاص بتحضير السطح حصريًا من أجل مظهر المستحضرات التي تم إكمالها باستخدام أدوات السطح Hilti FX 3-ST.

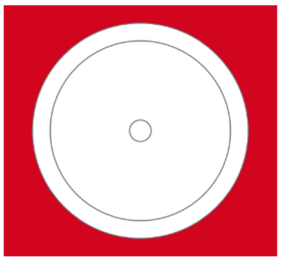
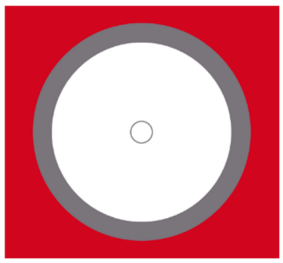
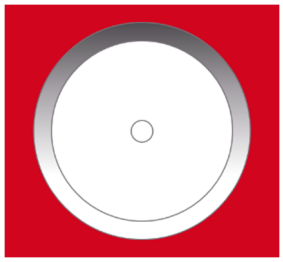
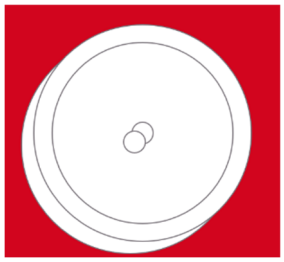
يستخدم كتالوج فحص Hilti F-BT من أجل سجل تأهيل إجراءات اللحام (WPQR/PQR) وكذلك لفحص المسامير أثناء التحكم في العملية والتحكم في اللحام ومراقبة الإنتاج.

يُوضح الجدول 1 كيفية قراءة الرسومات التخطيطية المستخدمة في هذا الكتالوج.

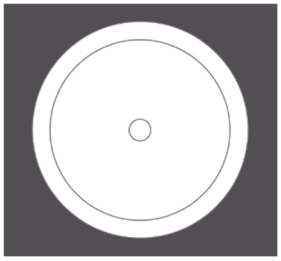
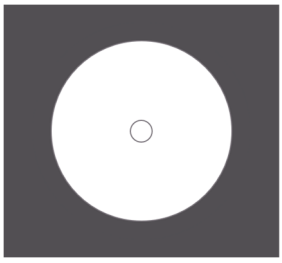
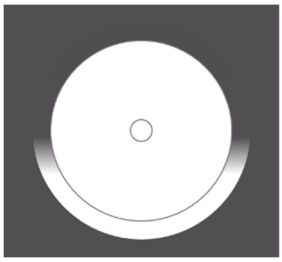
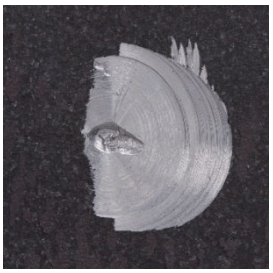
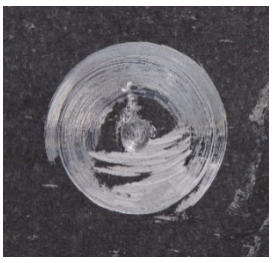
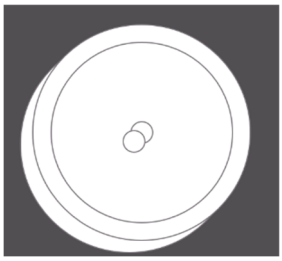
الجدول 1: شرح المخططات

المخطط	الشرح
فحص تحضير الأسطح	
	عرض تحضير السطح على الفولاذ المطلي من أعلى لأسفل. لون الطلاء أحمر في هذا المثال. تظهر حلقة خارجية في كلا المخططين . يُظهر المخطط الأيسر "حلقة لامعة" من الخارج. بينما يُظهر المخطط الأيمن حلقة بها بقايا، والتي يكون لون الطلاء بها أكثر بهتانًا. تمثل الدائرة الصغيرة في وسط كل مخطط المسافة البادئة التي شكلتها الحافة المركزية لأداة السطح.
فحص المسمار الملحوم	
	عرض شريحة F-BT ملحومة بالمادة الأصلية ومحضرّة باستخدام أداة السطح FX 3-ST d20 من أعلى لأسفل .
	عرض شريحة F-BT ملحومة بالمادة الأصلية ومحضرّة باستخدام أداة السطح FX 3-ST d14 من أعلى لأسفل .

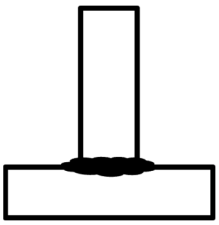
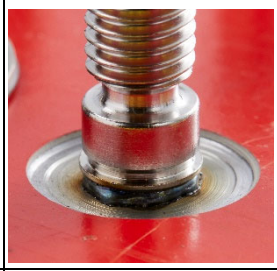
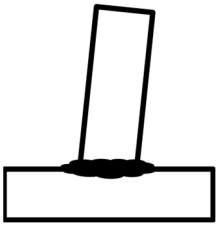
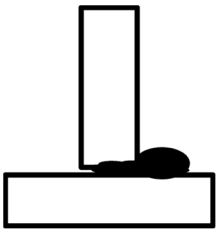
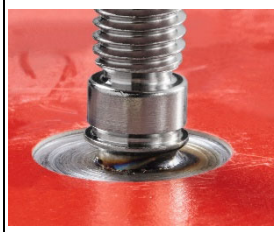
الجدول 2: تحضير السطح للمواد الأصلية المطلية بأداة السطح FX 3-ST d20

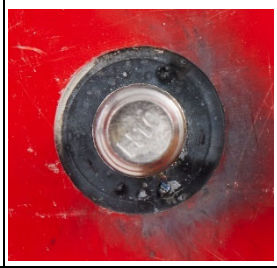
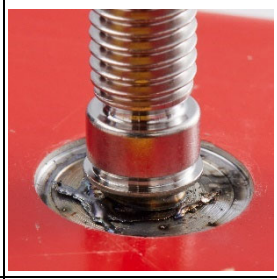
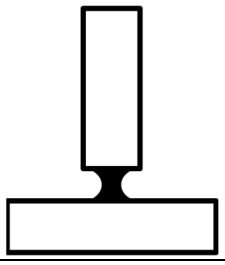
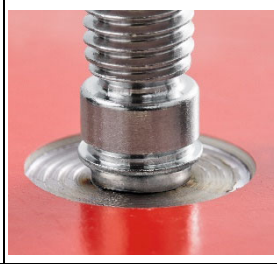
الرقم	المخططات	صور توضيحية	التقييم	الإجراءات التصحيحية الموصى بها
1		**حلقة فارغة ولامعة**  	**مقبول**	لا يوجد
2		**البقايا الموجودة على الحلقة الخارجية**  	**غير مقبول:** البقايا الموجودة على الحلقة الخارجية.	استمر في عملية التحضير حتى تصبح الحلقة الخارجية نظيفة بزاوية 360 درجة حولها. قم بتغيير أداة السطح إذا استدعى الأمر.
3		**سطح تحضير مائل**  	**غير مقبول:** بقايا من جانب واحد ومستحضرات مائلة.	استمر في عملية التحضير وقم بإمالة آلة الحفر قليلاً إلى الجانب، حيث توجد البقايا لتتم إزالتها وتوفير سطح مستوٍ لتركيب المسمار.
4		**تحضير غير مستوٍ**  	**غير مقبول:** البقايا الموجودة على السطح.	أمسك واضغط على الأداة مباشرة على السطح عند تحضيره. احرص على عدم اهتزاز أداة السطح.
5		**تحضير غير متماثل أو مضاعف**  	**غير مقبول:** تحضير غير متماثل يظهر دائرة مزدوجة.	لا تستخدم مستحضرات غير متماثلة في اللحام. قم بإنشاء مستحضر في مكان جديد. في المرة القادمة أمسك الأداة واضغط عليها بشكل مستقيم وثابت أثناء عملية التحضير.

الجدول 3: تحضير السطح للمواد الأصلية غير المطلية بأداة السطح FX 3-ST d14

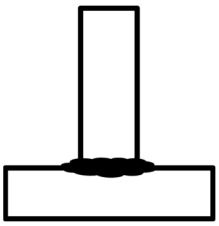
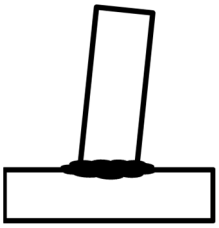
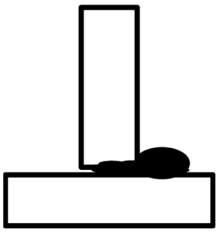
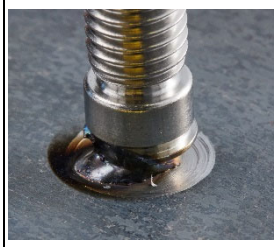
الرقم	المخططات	صور توضيحية	التقييم	الإجراءات التصحيحية الموصى بها
1	حلقة فارغة ولامعة 		**مقبول**	لا يوجد
2	البقايا الموجودة على الحلقة الخارجية 		**غير مقبول:** البقايا الموجودة على الحلقة.	استمر في عملية التحضير حتى تصبح الحلقة الخارجية نظيفة بزاوية 360 درجة حولها. قم بتغيير أداة السطح إذا استدعى الأمر.
3	سطح تحضير مائل 		**غير مقبول:** بقايا من جانب واحد ومستحضرات مائلة.	استمر في عملية التحضير وقم بإمالة آلة الحفر قليلاً إلى الجانب، حيث توجد البقايا لتتم إزالتها وتوفير سطح مستوٍ لتركيب المسمار.
4	تحضير غير مستوٍ 		**غير مقبول:** البقايا الموجودة على السطح.	أمسك واضغط على الأداة مباشرة على السطح عند تحضيره. احرص على عدم اهتزاز أداة السطح.
5	تحضير غير متماثل أو مضاعف 		**غير مقبول:** تحضير غير متماثل أو مضاعف.	لا تستخدم مستحضرات غير متماثلة في اللحام. قم بإنشاء مستحضر في مكان جديد. في المرة القادمة أمسك الأداة واضغط عليها بشكل مستقيم وثابت أثناء عملية التحضير.

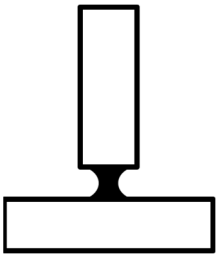
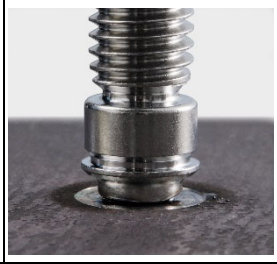
الجدول 4: كتالوج الفحص البصري لمسامير F-BT الملحومة بالفولاذ المطلي (أداة السطح FX 3-ST d20)

الرقم	المخططات	صور توضيحية	التقييم	الإجراءات التصحيحية الموصى بها	مكملة لـ
1		**طوق عادي وكامل** 	**مقبول**	لا يوجد.	الجدول A.5، رقم 4 من EN ISO 14555:2017
2		**مسمار** غير متمركزه 	**غير مقبول:** مسامير ملحومة غير متمركزه للتحضير الدائري. ☐ **إزالة وإعادة تركيب المسمار**	ضع طرف المسمار في منتصف السطح. أمسك الأداة اليدوية FX 3-HT في المنتصف وحافظ عليها عمودية.	الجدول A.5، رقم 4 من EN ISO 14555:2017
3		**مسمار مائل> 2 درجة** 	**غير مقبول:** مسامير مائلة> 2 درجة. ☐ **إزالة وإعادة تركيب المسمار**	أمسك الأداة اليدوية بشكل عمودي وثابت أثناء اللحام. تأكد من أن مستحضر السطح موازٍ لسطح المادة الأصلية.	الجدول A.5، رقم 4 من EN ISO 14555:2017
4		**وصلة من جانب واحد، إسقاط لحام بارز** 	**غير مقبول:** وصلة لحام من جانب واحد. ☐ قم باختبار أو إزالة المسمار الملحوم.	يتوافق مع متطلبات تحضير السطح في الجدول 2 . يتوافق مع متطلبات المشبك الأساسي، والمسمار، وتباعد الحواف.	الجدول A.5، رقم 4 من EN ISO 14555:2017 والمادة 9.7.1 من AWS D1.6 / 2017 :D1.6M

الرقم	المخططات	صور توضيحية	التقييم	الإجراءات التصحيحية الموصى بها	مكملة لـ
5		**قم بالتسخيم حول اللحام.** 	**غير مقبول:** المسامير المحاطة بالسخام حول اللحام. ☐ قم باختبار أو إزالة المسمار الملحوم.	يتوافق مع متطلبات تحضير السطح في الجدول 2. تأكد من أن مستحضر السطح والمسمار خاليان من أي تلوث.	الجدول A.5 رقم 3 و4 من EN ISO 14555:2017
6		**تناثر أو شرر** 	**غير مقبول:** المسامير المحاطة بالتناثر أو الشرر حول اللحام. ☐ قم باختبار أو إزالة المسمار الملحوم.	يتوافق مع متطلبات تحضير السطح في الجدول 2. تأكد من أن مستحضر السطح والمسمار خاليان من أي تلوث.	الجدول A.5 رقم 3 و5 من EN ISO 14555:2017 والمادة 9.7.1 من AWS D1.6 / 2017 :D1.6M
7		**قطر اللحام منخفض، مباعد غير عادي** 	**غير مقبول:** مسامير ذات قطر منخفض أو مباعد عالٍ غير عادي. ☐ **إزالة وإعادة تركيب** المسمار	تحقق من إعداد رمز اللحام (رمز H). يتوافق مع متطلبات تحضير السطح في الجدول 2. تأكد من أن مستحضر السطح والمسمار خاليان من أي تلوث.	الجدول A.5، رقم 2 من EN ISO 14555:2017 و المادة 9.7.1 من AWS D1.6 / 2017 :D1.6M
8		**يتم عرض الرمز F على الأداة** 	**غير مقبول:** يتم عرض المسامير ذات الرمز F بعد اللحام. ☐ اتبع الإجراءات المطلوبة في الجدول 6	\الإجراءات التصحيحية ذات الرمز F مدرجة في الجدول 6.	

الجدول 5: كتالوج الفحص البصري لمسامير F-BT الملحومة بالفولاذ غير المطلي (أداة السطح FX 3-ST d14)

الرقم	المخططات	صور توضيحية	التقييم	الإجراءات التصحيحية الموصى بها	مكملة لـ
1		**طوق كامل عادي حول دبوس اللحام** 	**مقبول**	لا يوجد.	الجدول A.5، رقم 4 من EN ISO 14555:2017
2		**مسمار** غير متمركزه 	**غير مقبول:** مسامير ملحومة غير متمركزه للتحضير الدائري. ☐ **إزالة وإعادة تركيب المسمار**	ضع طرف المسمار في منتصف السطح. أمسك الأداة اليدوية FX 3-HT في المنتصف وحافظ عليها عمودية.	الجدول A.5، رقم 4 من EN ISO 14555:2017
3		**مسمار مائل> 2 درجة** 	**غير مقبول:** مسامير مائلة> 2 درجة. ☐ **إزالة وإعادة تركيب المسمار**	أمسك الأداة اليدوية بشكل عمودي وثابت أثناء اللحام. تأكد من أن مستحضر السطح موازٍ لسطح المادة الأصلية.	الجدول A.5، رقم 4 من EN ISO 14555:2017
4		**وصلة من جانب واحد، إسقاط لحام بارز** 	**غير مقبول:** وصلة لحام من جانب واحد. ☐ قم باختبار أو إزالة المسمار الملحوم.	يتوافق مع متطلبات تحضير السطح في الجدول 2 . يتوافق مع متطلبات المشبك الأساسي، والمسمار، وتباعد الحواف.	الجدول A.5، رقم 4 من EN ISO 14555:2017 و المادة 9.7.1 من AWS D1.6 / 2017 :D1.6M

الرقم	المخططات	صور توضيحية	التقييم	الإجراءات التصحيحية الموصى بها	مكملة لـ
5		**قم بالتسخيم حول اللحام.** 	**غير مقبول:** المسامير المحاطة بالسخام حول اللحام. ☐ قم باختبار أو إزالة المسمار الملحوم.	يتوافق مع متطلبات تحضير السطح في الجدول 3. تأكد من أن مستحضر السطح والمسمار خاليان من أي تلوث.	الجدول A.5 رقم 3 و4 من EN ISO 14555:2017
6		**تناثر أو شرر** 	**غير مقبول:** المسامير المحاطة بالتناثر أو الشرر حول اللحام. ☐ قم باختبار أو إزالة المسمار الملحوم.	يتوافق مع متطلبات تحضير السطح في الجدول 3. تأكد من أن مستحضر السطح والمسمار خاليان من أي تلوث.	الجدول A.5، سرقم 3 و5 من EN ISO 14555:2017 و المادة 9.7.1 من AWS D1.6 / 2017 :D1.6M
7		**قطر اللحام منخفض، مباعد غير عادي** 	**غير مقبول:** مسامير ذات قطر منخفض أو مباعد عالٍ غير عادي. ☐ **إزالة وإعادة تركيب المسمار**	تحقق من إعداد رمز اللحام. يتوافق مع متطلبات تحضير السطح في الجدول 3. تأكد من أن مستحضر السطح والمسمار خاليان من أي تلوث.	الجدول A.5، رقم 2 من EN ISO 14555:2017 و المادة 9.7.1 من AWS D1.6 / 2017 :D1.6M
8		**يتم عرض الرمز F على الأداة** 	**غير مقبول:** يتم عرض المسامير ذات الرمز F بعد اللحام. ☐ اتبع الإجراءات المطلوبة في الجدول 6	\الإجراءات التصحيحية ذات الرمز F مدرجة في الجدول 6.	

الجدول 6: *قائمة الرمز F، حالة الفشلالتي تتطلب إزالة أو فحص المسمار*

<table>
<tr><th>الرمز F</th><th>حالة الفشل</th><th>الإجراء المطلوب</th></tr>
<tr><td>F06</td><td>ميكانيكا الأداة اليدوية الداخلية لزجة</td><td rowspan="4">إما:
اختبر صمود الحمولة الخاصة بالمسمار باستخدام HAT 28 FX.
يعتمد صمود الحمولة على رمز اللحام (الرمز H) للمسمار. إذا تحمّل المسمار الحمولة، فمن الجيد استخدامه، وإلا يجب إعادة تثبيته.
<table><tr><th>رمز اللحام (الرمز H)</th><th>صمود الحمولة بالكيلو نيوتن (lbf)</th></tr><tr><td>H1</td><td>6 (1350)</td></tr><tr><td>H2</td><td>9 (2025)</td></tr><tr><td>H3</td><td>17 (3820)</td></tr><tr><td>H10</td><td>22 (4950)</td></tr></table>أو:
قم بإزالة مسمار التثبيت وإعادة تثبيته مباشرة دون اختبار.</td></tr>
<tr><td>F07</td><td>التوصيل الكهربائي رديء</td></tr>
<tr><td>F10</td><td>تعشيق المسمار ليس مناسبًا</td></tr>
<tr><td>F14</td><td>توقف المشغل عن العمل</td></tr>
<tr><td>F16</td><td>بقعة ملوثة</td><td></td></tr>
<tr><td>F17</td><td>تم إيقاف العملية</td><td>إزالة وإعادة تركيب المسمار</td></tr>
</table>

- للإجراءات التصحيحية لتجنب تكرار الرموز F، انظر الملصق داخل صندوق المجموعة.
- لاستكشاف وإصلاح أخطاء رموز F غير المدرجة هنا، انظر الملصق داخل صندوق الأدوات.
- يمكن العثور على توصية حول كيفية إزالة وإعادة تثبيت F-BT في إجراءات إصلاح F-BT.

CATALOGUE NG BISWAL NA EKSAMINASYON NG HILTI F-BT

Nakahati sa dalawang bahagi ang biswal na eksaminasyon at pagsusuri para sa mga Hilti F-BT stud.

Una, ang eksaminasyon ng paghahanda ng surface (Talahanayan 2 at Talahanayan 3) bago ang paghihinang at pangalawa, ang eksaminasyon para sa paghihinang mismo ng F-BT stud (Talahanayan 4 at Talahayan 5).

Ang layunin ng catalogue ng eksaminasyon ay para masuri ang biswal na hitsura bilang katanggap-tanggap o hindi katanggap-tanggap na gamitin.

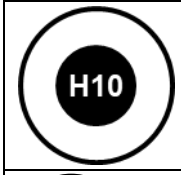
Ang mga pamantayan para sa hitsura ng stud ay karagdagan sa mga iniaatas ng EN ISO 14555:2017 Talahanayan A.5 at AWS D1.6 Clause 9.7. Gamit ang mga pamantayang ito bilang batayan, isinasaad ng dokumentong ito ang mga detalye ng mga nakahinang na Hilti F-BT stud.

Ang catalogue ng eksaminasyon para sa paghahanda ng surface ay eksklusibong ginawa para sa hitsura ng mga paghahanda na kinumpleto gamit ang mga Hilti FX 3-ST surface tool.

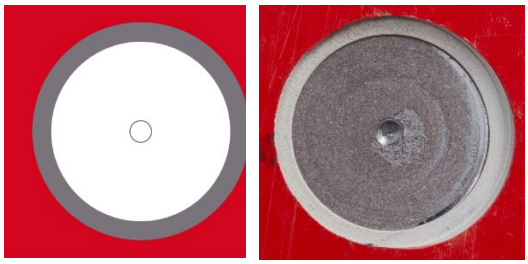
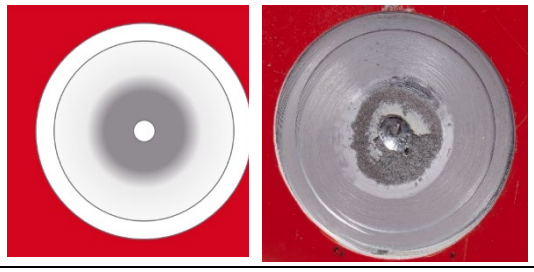
Gagamitin ang catalogue ng eksaminasyon ng Hilti F-BT para sa welding procedure qualification record (WPQR/PQR) pati na rin para sa eksaminasyon ng stud sa panahon ng pagkontrol sa proseso, pagkontrol sa paghihinang sa produksyon, at pagbabantay sa produksyon.

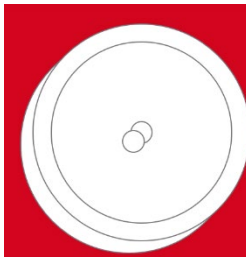
Nagbibigay ang Talahanayan 1 ng paliwanag kung paano basahin ang mga sketch ng schematic na ginagamit sa catalogue na ito.

Talahanayan 1: Paliwanag sa mga schematic

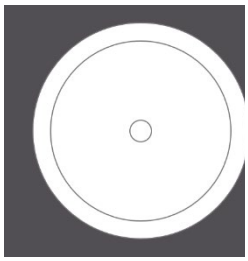
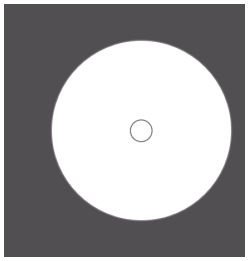
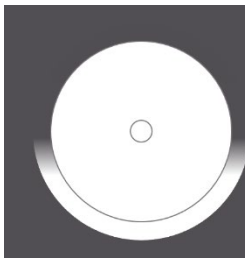
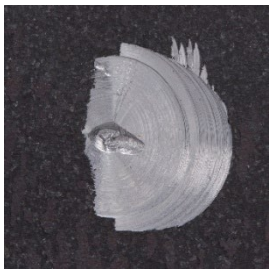
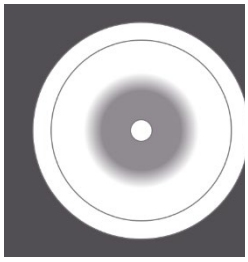
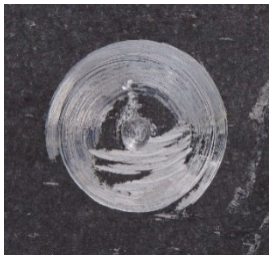
Schematic	Paliwanag
Eksaminasyon sa paghahanda ng surface	
	Top-down view ng paghahanda ng surface sa may coating na steel. Sa halimbawang ito, pula ang kulay ng coating. Sa dalawang schematic, may outer ring na ipinapakita. Ang kaliwang schematic ay nagpapakita ng “makintab na ring” sa labas. Ang kanang schematic naman ay nagpapakita ng ring na may mga residual, na hindi makintab ang kulay. Ang maliit na bilog sa gitna ng bawat schematic ay nagrerepresenta sa markang nagawa ng gitnang tip ng surface tool.
Eskaminasyon sa nakahinang na stud	
	Top-down view ng F-BT na nakahinang sa parent na materyal na inihanda gamit ang FX 3-ST d20 surface tool.
	Top-down view ng F-BT na nakahinang sa parent na materyal na inihanda gamit ang FX 3-ST d14 surface tool.

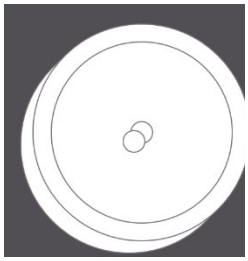
Talahanayan 2: Paghahanda ng surface ng may coating na parent na materyal gamit ang surface tool na FX 3-ST d20

Hindi	Mga schematic	Mga halimbawang larawan	Pagsusuri	Inirerekomendang pangwastong pagkilos
1	**Blangko at makintab na ring**		**KATANGGAP-TANGGAP**	Wala
2	**Mga residual sa outer ring**		**HINDI KATANGGAP-TANGGAP:** Mga residual sa outer ring.	Ipagpatuloy ang proseso ng paghahanda hanggang maging malinis ang 360° na paligid ng stop shoulder (outer ring). Palitan ang surface tool kung kinakailangan.
3	**Surface ng nakahilig na paghahanda**		**HINDI KATANGGAP-TANGGAP:** Mga one-sided na residual at mga nakahilig na paghahanda.	Ipagpatuloy ang proseso ng paghahanda at bahagyang itagilid ang drilling machine sa bahaging kinaroroonan ng mga residual para maalis ang mga ito at magkaroon ng pantay na surface para sa pagkakabit ng stud.
4	**Hindi pantay na paghahanda**		**HINDI KATANGGAP-TANGGAP:** Mga residual sa surface.	Hawakan at idiin ang tool nang direkta sa surface kapag inihahanda ang surface. Iwasang gumewang ang surface tool.

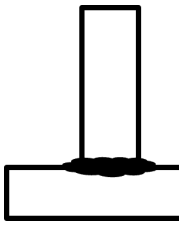
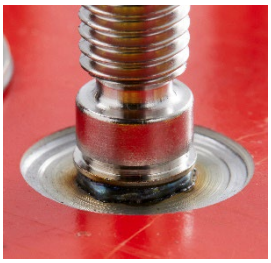
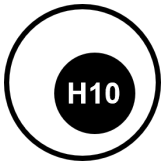
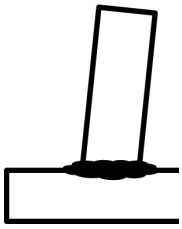
Hindi	Mga schematic	Mga halimbawang larawan	Pagsusuri	Inirerekomendang pangwastong pagkilos
5	**Hindi symmetrical o nadobleng paghahanda** 		**HINDI KATANGGAP-TANGGAP:** Isang hindi symmetrical na paghahanda na nagpapakita ng dobleng bilog.	Huwag gumamit ng mga hindi symmetrical na paghahanda para sa paghihinang. Gumawa ng paghahanda sa bagong lokasyon. Sa susunod, hawakan at idiin ang tool nang direkta at hindi gumagalaw sa proseso ng paghahanda.

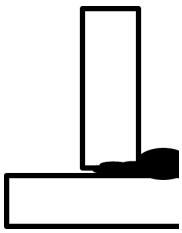
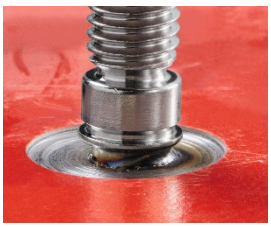
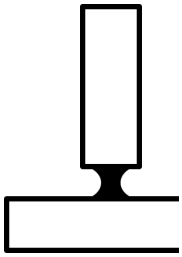
Talahanayan 3: Paghahanda ng surface ng walang coating na parent na materyal gamit ang surface tool na FX 3-ST d14

Hindi	Mga schematic	Mga halimbawang larawan	Pagsusuri	Inirerekomendang pangwastong pagkilos
1	**Blangko at makintab na ring** 		**KATANGGAP-TANGGAP**	Wala
2	**Mga residual sa outer ring** 		**HINDI KATANGGAP-TANGGAP:** Mga residual sa ring.	Ipagpatuloy ang proseso ng paghahanda hanggang maging malinis ang 360° na paligid ng stop shoulder (outer ring). Palitan ang surface tool kung kinakailangan.
3	**Surface ng nakahilig na paghahanda** 		**HINDI KATANGGAP-TANGGAP:** Mga one-sided na residual at mga nakahilig na paghahanda.	Ipagpatuloy ang proseso ng paghahanda at bahagyang itagilid ang drilling machine sa bahaging kinaroroonan ng mga residual para maalis ang mga ito at magkaroon ng pantay na surface para sa pagkakabit ng stud.
4	**Hindi pantay na paghahanda** 		**HINDI KATANGGAP-TANGGAP:** Mga residual sa surface.	Hawakan at idiin ang tool nang direkta sa surface kapag inihahanda ang surface. Iwasang gumewang ang surface tool.

Hindi	Mga schematic	Mga halimbawang larawan	Pagsusuri	Inirerekomendang pangwastong pagkilos
5	**Hindi symmetrical o nadobleng paghahanda** 		**HINDI KATANGGAP-TANGGAP:** Isang hindi symmetrical o nadobleng paghahanda.	Huwag gumamit ng mga hindi symmetrical na paghahanda para sa paghihinang. Gumawa ng paghahanda sa bagong lokasyon. Sa susunod, hawakan at idiin ang tool nang direkta at hindi gumagalaw sa proseso ng paghahanda.

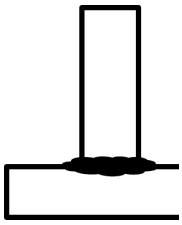
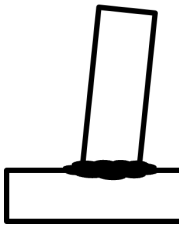
Talahanayan 4: Catalogue ng biswal na eksaminasyon para sa mga F-BT stud na nakahinang sa may coating na steel (surface tool na FX 3-ST d20)

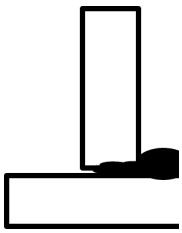
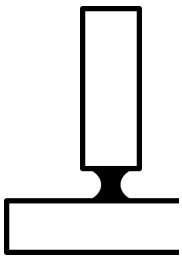
Hindi	Mga schematic	Mga halimbawang larawan	Pagsusuri	Inirerekomendang pangwastong pagkilos	Karagdagan sa
1	**Regular at complete na collar** 		**KATANGGAP-TANGGAP**	Wala.	Talahanayan A.5, Num. 4 ng EN ISO 14555:2017
2	**Eksentrikong stud** 		**HINDI KATANGGAP-TANGGAP:** Mga stud na nakahinang nang eksentriko sa pabilog na paghahanda. → **Alisin at ikabit ulit** ang stud	Isentro ang dulo ng stud sa gitna ng paghahanda ng surface. Hawakan ang hand tool na FX 3-HT nang nakasentro, perpendikular, at banayad.	Talahanayan A.5, Num. 4 ng EN ISO 14555:2017
3	**Nakahilig na stud na >2°** 		**HINDI KATANGGAP-TANGGAP:** Mga nakahilig na stud na >2°. → **Alisin at ikabit ulit** ang stud	Hawakan ang hand tool nang perpendikular at hindi gumagalaw habang naghihinang. Tiyaking ang paghahanda ng surface ay parallel sa surface ng parent na materyal.	Talahanayan A.5, Num. 4 ng EN ISO 14555:2017

Hindi	Mga schematic	Mga halimbawang larawan	Pagsusuri	Inirerekomendang pangwastong pagkilos	Karagdagan sa
4	**One-sided na koneksyon, nakausli ang weld drop** 		**HINDI KATANGGAP-TANGGAP:** One-sided na koneksyon ng hinang. → **Subukan o alisin** ang nakahinang na stud	Sumunod sa mga iniaatas sa paghahanda ng surface sa Talahanayan 2. Sumunod sa mga iniaatas sa spacing ng base clamp, stud, at edge.	Talahanayan A.5, Num. 4 ng EN ISO 14555:2017 at Clause 9.7.1 ng AWS D1.6/D1.6M: 2017
5	**Agiw sa paligid ng hinang** 		**HINDI KATANGGAP-TANGGAP:** Mga stud na may agiw sa paligid ng hinang. → **Subukan o alisin** ang nakahinang na stud	Sumunod sa mga iniaatas sa paghahanda ng surface sa Talahanayan 2. Tiyaking walang anumang kontaminasyon ang paghahanda ng surface at ang stud.	Talahanayan A.5, Num. 3 at 4 ng EN ISO 14555:2017
6	**Tilamsik o mga spark** 		**HINDI KATANGGAP-TANGGAP:** Mga stud na may tilamsik o spark sa paligid ng hinang. → **Subukan o alisin** ang nakahinang na stud	Sumunod sa mga iniaatas sa paghahanda ng surface sa Talahanayan 2. Tiyaking walang anumang kontaminasyon ang paghahanda ng surface at ang stud.	Talahanayan A.5, Num. 3 at 5 ng EN ISO 14555:2017 at Clause 9.7.1 ng AWS D1.6/D1.6M: 2017
7	**Lumiit na diameter ng hinang, hindi karaniwang stand off** 		**HINDI KATANGGAP-TANGGAP:** Mga stud na may lumiit na diameter o hindi karaniwang mataas na stand-off. → **Alisin at ikabit ulit** ang stud	Tingnan ang setting ng Weld Code (H-Code). Sumunod sa mga iniaatas sa paghahanda ng surface sa Talahanayan 2. Tiyaking walang anumang kontaminasyon ang paghahanda ng surface at ang stud.	Talahanayan A.5, Num. 2 ng EN ISO 14555:2017 at Clause 9.7.1 ng AWS D1.6/D1.6M: 2017

Hindi	Mga schematic	Mga halimbawang larawan	Pagsusuri	Inirerekomendang pangwastong pagkilos	Karagdagan sa
8	**F-Code na ipinapakita sa tool**  		**HINDI KATANGGAP-TANGGAP:** Mga stud na may F-Code na ipinapakita pagkatapos ng hinang. → **Sundin ang mga pagkilos na kinakailangan sa** Talahanayan 6	Mga pangwastong pagkilos na nakadepende sa F-Code na nakalista sa Talahanayan 6.	

Talahanayan 5: Catalogue ng biswal na eksaminasyon para sa mga F-BT stud na nakahinang sa walang coating na steel (surface tool na FX 3-ST d14)

Hindi	Mga schematic	Mga halimbawang larawan	Pagsusuri	Inirerekomendang pangwastong pagkilos	Karagdagan sa
1	**Regular at complete na collar sa paligid ng weld pin** 		**KATANGGAP-TANGGAP**	Wala.	Talahanayan A.5, Num. 4 ng EN ISO 14555:2017
2	**Eksentrikong stud** 		**HINDI KATANGGAP-TANGGAP:** Mga stud na nakahinang nang eksentriko sa pabilog na paghahanda. → **Alisin at ikabit ulit** ang stud	Isentro ang dulo ng stud sa gitna ng paghahanda ng surface. Hawakan ang hand tool na FX 3-HT nang nakasentro, perpendikular, at banayad.	Talahanayan A.5, Num. 4 ng EN ISO 14555:2017
3	**Nakahilig na stud na >2°** 		**HINDI KATANGGAP-TANGGAP:** Mga nakahilig na stud na >2°. → **Alisin at ikabit ulit** ang stud	Hawakan ang hand tool nang perpendikular at hindi gumagalaw habang naghihinang. Tiyaking ang paghahanda ng surface ay parallel sa surface ng parent na materyal.	Talahanayan A.5, Num. 4 ng EN ISO 14555:2017

Hindi	Mga schematic	Mga halimbawang larawan	Pagsusuri	Inirerekomendang pangwastong pagkilos	Karagdagan sa
4	**One-sided na koneksyon, nakausli ang weld drop** 		**HINDI KATANGGAP-TANGGAP:** One-sided na koneksyon ng hinang. → **Subukan o alisin** ang nakahinang na stud	Sumunod sa mga iniaatas sa paghahanda ng surface sa Talahanayan 2. Sumunod sa mga iniaatas sa spacing ng base clamp, stud, at edge.	Talahanayan A.5, Num. 4 ng EN ISO 14555:2017 at Clause 9.7.1 ng AWS D1.6/D1.6M: 2017
5	**Agiw sa paligid ng hinang** 		**HINDI KATANGGAP-TANGGAP:** Mga stud na may agiw sa paligid ng hinang. → **Subukan o alisin** ang nakahinang na stud	Sumunod sa mga iniaatas sa paghahanda ng surface sa Talahanayan 3. Tiyaking walang anumang kontaminasyon ang paghahanda ng surface at ang stud.	Talahanayan A.5, Num. 3 at 4 ng EN ISO 14555:2017
6	**Tilamsik o mga spark** 		**HINDI KATANGGAP-TANGGAP:** Mga stud na may tilamsik o spark sa paligid ng hinang. → **Subukan o alisin** ang nakahinang na stud	Sumunod sa mga iniaatas sa paghahanda ng surface sa Talahanayan 3. Tiyaking walang anumang kontaminasyon ang paghahanda ng surface at ang stud.	Talahanayan A.5, Num. 3 at 5 ng EN ISO 14555:2017 at Clause 9.7.1 ng AWS D1.6/D1.6M: 2017
7	**Lumiit na diameter ng hinang, hindi karaniwang stand off** 		**HINDI KATANGGAP-TANGGAP:** Mga stud na may lumiit o hindi karaniwang mataas na stand-off. → **Alisin at ikabit ulit** ang stud	Tingnan ang setting ng Weld Code. Sumunod sa mga iniaatas sa paghahanda ng surface sa Talahanayan 3. Tiyaking walang anumang kontaminasyon ang paghahanda ng surface at ang stud.	Talahanayan A.5, Num. 2 ng EN ISO 14555:2017 at Clause 9.7.1 ng AWS D1.6/D1.6M: 2017

Hindi	Mga schematic	Mga halimbawang larawan	Pagsusuri	Inirerekomendang pangwastong pagkilos	Karagdagan sa
8	**F-Code na ipinapakita sa tool**  		**HINDI KATANGGAP-TANGGAP:** Mga stud na may F-Code na ipinapakita pagkatapos ng hinang. → **Sundin ang mga pagkilos na kinakailangan sa** Talahanayan 6	Mga pangwastong pagkilos na nakadepende sa F-Code na nakalista sa Talahanayan 6.	

Talahanayan 6: Listahan ng F-Code, kaso ng pagpalya na nangangailangan ng pag-aalis o inspeksyon ng stud

<table>
<tr><th>F-Code</th><th>Kaso ng pagpalya</th><th>Kinakailangang pagkilos</th></tr>
<tr><td>F06</td><td>Malagkit ang mga loob na mekanismo ng hand tool</td><td rowspan="5">Maaaring:
Subukan ang stud sa tensile proof load gamit ang HAT 28 FX.
Ang proof load ay nakadepende sa Weld Code (H-Code) ng stud. Kung kakayanin ng stud ang proof load, maaari itong gamitin, kung hindi, kailangan itong ikabit ulit.
<table><tr><th>Weld code (H-Code)</th><th>Tensile proof load sa kN (lbf)</th></tr><tr><td>H1</td><td>6 (1350)</td></tr><tr><td>H2</td><td>9 (2025)</td></tr><tr><td>H3</td><td>17 (3820)</td></tr><tr><td>H10</td><td>22 (4950)</td></tr></table>
O kaya:
Alisin at ikabit ulit ang stud nang direkta nang hindi sinusubukan.</td></tr>
<tr><td>F07</td><td>Hindi maganda ang elektrikal na koneksyon</td></tr>
<tr><td>F10</td><td>Hindi maayos ang pagkakabaon ng stud</td></tr>
<tr><td>F14</td><td>Inihinto ng operator ang proseso</td></tr>
<tr><td>F16</td><td>May bahaging kontaminado</td></tr>
<tr><td>F17</td><td>Itinigil ang proseso</td><td>Alisin at ikabit ulit ang stud</td></tr>
</table>

- Para sa mga pangwastong pagkilos para maiwasang mangyari ulit ang mga F-Code, tingnan ang Sticker sa loob ng Kit box.
- Para sa pag-troubleshoot ng mga F-Code na hindi nakalista rito, tingnan ang Sticker sa loob ng Kit box.
- Ang rekomendasyon kung paano mag-alis at magkabit ulit ng F-BT ay makikita sa pamamaraan ng pag-aayos para sa F-BT.

GUIDE POUR L'INSPECTION VISUELLE DES GOUJONS HILTI F-BT

Le processus d'inspection visuelle et d'évaluation des goujons Hilti F-BT se compose de deux parties.

La préparation de la surface (tableaux 2 et 3) est d'abord vérifiée avant le soudage, puis la soudure du goujon F-BT proprement dite est contrôlée (tableaux 4 et 5).

Ce guide permet d'évaluer visuellement l'apparence de la surface et des goujons et de déterminer s'ils sont acceptables ou non pour l'utilisation.

Les critères d'apparence du goujon viennent compléter les exigences des normes EN ISO 14555:2017, tableau A.5, et AWS D1.6, point 9.7. En s'appuyant sur ces normes, le présent document traite des caractéristiques des goujons Hilti F-BT à souder.

Le guide pour l'inspection de la préparation de la surface s'applique uniquement au contrôle de l'apparence des préparations réalisées avec l'outil de surface Hilti FX 3-ST.

Le guide pour l'inspection Hilti F-BT doit être utilisé pour le dossier de qualification de la procédure de soudage (WPQR/PQR), ainsi que pour l'inspection des goujons lors du contrôle du procédé, du contrôle du soudage de production et de la surveillance de la production.

Le tableau 1 explique les schémas utilisés dans ce guide.

Tableau 1 : explication des schémas

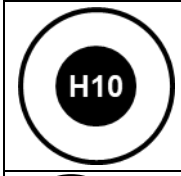
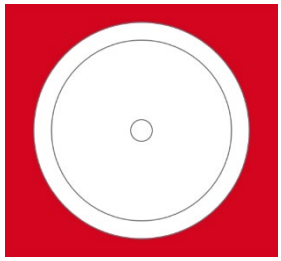
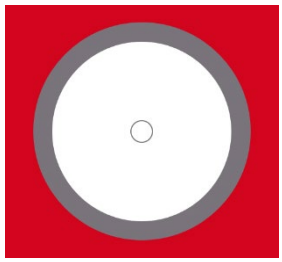
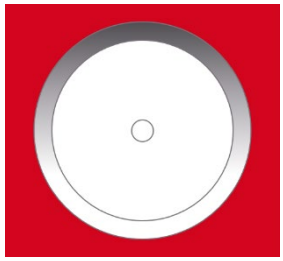
Schéma	Explication
Inspection de la préparation de la surface	
	Vue de dessus d'une préparation de surface sur de l'acier revêtu. Dans cet exemple, la couleur du revêtement est rouge. Dans les deux schémas, on a représenté un anneau externe. Le schéma de gauche montre un anneau « brillant », alors que le schéma de droite montre un anneau avec des résidus, représentés par une couleur plus sombre. Le petit cercle au centre de chaque schéma représente la marque formée par la pointe de l'outil de surface.
Inspection du goujon soudé	
	Vue de dessus d'un F-BT soudé sur le matériau de départ préparé avec l'outil de surface FX 3-ST d20.
	Vue de dessus d'un F-BT soudé sur le matériau de départ préparé avec l'outil de surface FX 3-ST d14.

Tableau 2 : Préparation de la surface d'un matériau de départ revêtu avec l'outil de surface FX 3-ST d20

N°	Schémas	Exemples (photos)	Évaluation	Action corrective recommandée
1	**Anneau propre et brillant** 		**ACCEPTABLE**	Aucune
2	**Résidus sur l'anneau extérieur** 		**NON ACCEPTABLE :** résidus sur l'anneau extérieur.	Poursuivre la préparation jusqu'à ce que l'épaulement d'arrêt (anneau extérieur) soit propre sur 360°. Remplacer l'outil de surface si nécessaire.
3	**Surface inclinée** 		**NON ACCEPTABLE :** résidus sur un côté et préparation inclinée	Poursuivre la préparation et incliner la perceuse légèrement sur le côté où se trouvent les résidus afin de les retirer et réaliser une surface plane pour la pose du goujon.
4	**Surface non plane** 		**NON ACCEPTABLE :** résidus à la surface.	Maintenir et presser l'outil bien droit sur la surface pour effectuer la préparation. Éviter de faire osciller l'outil.

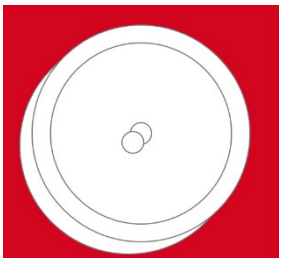
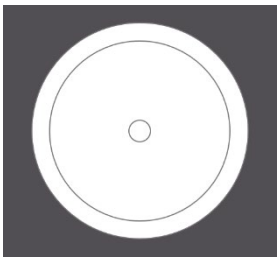
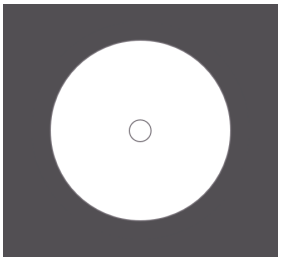
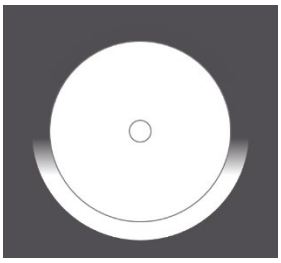
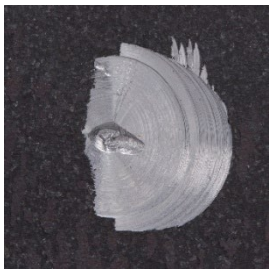
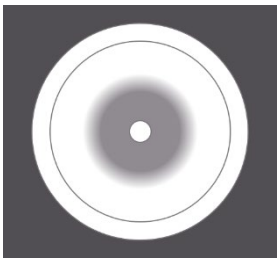
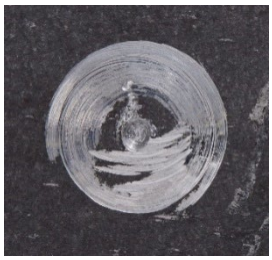
N°	Schémas	Exemples (photos)	Évaluation	Action corrective recommandée
5	**Préparation asymétrique ou double** 		**NON ACCEPTABLE :** préparation asymétrique avec deux cercles.	Ne pas utiliser de préparations asymétriques pour le soudage. Réaliser une préparation à un autre endroit. Pour la prochaine préparation, maintenir fermement l’outil et appuyer en veillant à ce qu'il soit bien droit.

Tableau 3 : Préparation de la surface d'un matériau de départ non revêtu avec l'outil de surface FX 3-ST d14

N°	Schémas	Exemples (photos)	Évaluation	Action corrective recommandée
1	**Anneau propre et brillant** 		**ACCEPTABLE**	Aucune
2	**Résidus sur l'anneau extérieur** 		**NON ACCEPTABLE :** résidus sur l'anneau.	Poursuivre la préparation jusqu'à ce que l'épaulement d'arrêt (anneau extérieur) soit propre sur 360°. Remplacer l'outil de surface si nécessaire.
3	**Surface inclinée** 		**NON ACCEPTABLE :** résidus sur un côté et préparation inclinée	Poursuivre la préparation et incliner la perceuse légèrement sur le côté où se trouvent les résidus afin de les retirer et réaliser une surface plane pour la pose du goujon.
4	**Surface non plane** 		**NON ACCEPTABLE :** résidus à la surface.	Maintenir et presser l'outil bien droit sur la surface pour effectuer la préparation. Éviter de faire osciller l'outil.

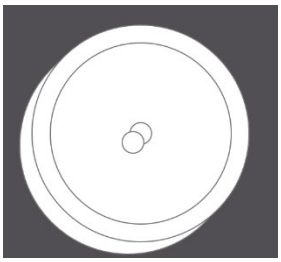
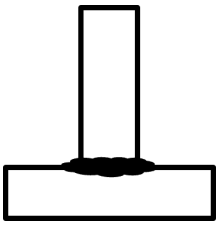
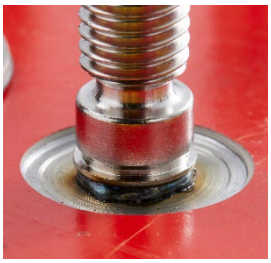
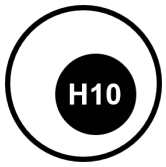
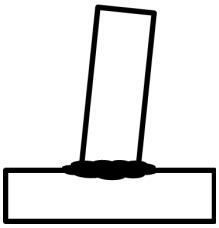
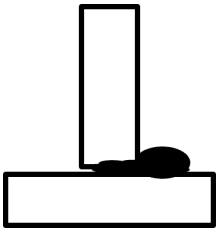
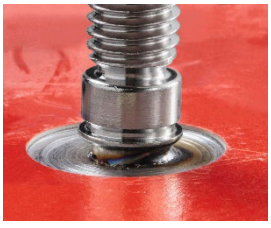
N°	Schémas	Exemples (photos)	Évaluation	Action corrective recommandée
5	**Préparation asymétrique ou double** 		**NON ACCEPTABLE :** préparation asymétrique ou double.	Ne pas utiliser de préparations asymétriques pour le soudage. Réaliser une préparation à un autre endroit. Pour la prochaine préparation, maintenir fermement l’outil et appuyer en veillant à ce qu'il soit bien droit.

Tableau 4 : Guide pour l'inspection visuelle des goujons F-BT soudés sur de l'acier revêtu (outil de surface FX 3-ST d20)

N°	Schémas	Exemples (photos)	Évaluation	Action corrective recommandée	Complémentaire à
1	**Collerette régulière et complète** 		**ACCEPTABLE**	Aucune.	Tableau A.5, n° 4 de l'EN ISO 14555:2017
2	**Goujon excentré** 		**NON ACCEPTABLE :** goujon soudé excentré par rapport à la préparation circulaire. → **Retirer et reposer** le goujon	Centrer la pointe du goujon sur la surface préparée. Maintenir tranquillement l'outil à main FX 3-HT de manière perpendiculaire et centrée.	Tableau A.5, n° 4 de l'EN ISO 14555:2017
3	**Goujon incliné >2°** 		**NON ACCEPTABLE :** goujon incliné >2° → **Retirer et reposer** le goujon	Maintenir fermement l'outil à main de manière perpendiculaire pendant le soudage. S'assurer que la préparation de la surface est parallèle à la surface du matériau de départ.	Tableau A.5, n° 4 de l'EN ISO 14555:2017
4	**Jointure sur un seul côté, soudure protubérante** 		**NON ACCEPTABLE :** soudure sur un seul côté. → **Soumettre à l'essai** le goujon soudé ou le **retirer**	Respecter les exigences relatives à la préparation de la surface figurant au Tableau 2. Respecter les exigences relatives à l'attache de base, au goujon et à l'espacement du bord.	Tableau A.5, n° 4 de l'EN ISO 14555:2017 et point 9.7.1 de l'AWS D1.6/D1.6M: 2017

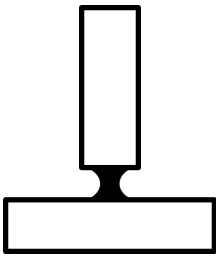
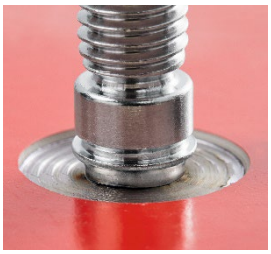
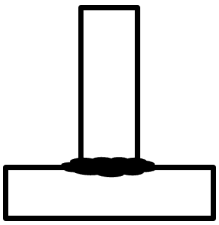
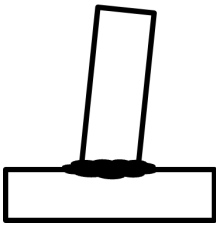
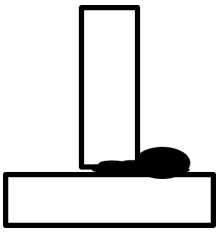
N°	Schémas	Exemples (photos)	Évaluation	Action corrective recommandée	Complémentaire à
5	**Suie autour de la soudure** 		**NON ACCEPTABLE :** le goujon présente de la suie autour de la soudure. → **Soumettre à l'essai** le goujon soudé ou le **retirer**	Respecter les exigences relatives à la préparation de la surface figurant au Tableau 2. S'assurer que la préparation de la surface et le goujon sont exempts de contaminants.	Tableau A.5, n° 3 et 4 de l'EN ISO 14555:2017
6	**Éclaboussure ou étincelle** 		**NON ACCEPTABLE :** le goujon présente des éclaboussures ou des étincelles autour de la soudure. → **Soumettre à l'essai** le goujon soudé ou le **retirer**	Respecter les exigences relatives à la préparation de la surface figurant au Tableau 2. S'assurer que la préparation de la surface et le goujon sont exempts de contaminants.	Tableau A.5, n° 3 et 5 de l'EN ISO 14555:2017 et point 9.7.1 de l'AWS D1.6/D1.6M: 2017
7	**Diamètre de soudure réduit, partie visible inhabituelle** 		**NON ACCEPTABLE :** goujon avec diamètre réduit ou partie visible haute et inhabituelle. → **Retirer et reposer** le goujon	Vérifier le réglage du code de soudage (code H). Respecter les exigences relatives à la préparation de la surface figurant au Tableau 2. S'assurer que la préparation de la surface et le goujon sont exempts de contaminants.	Tableau A.5, n° 2 de l'EN ISO 14555:2017 et point 9.7.1 de l'AWS D1.6/D1.6M: 2017
8	**Code F affiché sur l'outil** 		**NON ACCEPTABLE :** goujons avec code F affiché après la soudure. → **Exécuter les actions demandées au** Tableau 6	Actions correctives selon le code F listées au Tableau 6.	

Tableau 5 : Guide de l'inspection visuelle pour goujons F-BT soudés sur de l'acier non revêtu (outil de surface FX 3-ST d14)

N°	Schémas	Exemples (photos)	Évaluation	Action corrective recommandée	Complémentaire à
1	**Collerette régulière et complète autour du goujon soudé** 		**ACCEPTABLE**	Aucune.	Tableau A.5, n° 4 de l'EN ISO 14555:2017
2	**Goujon excentré** 		**NON ACCEPTABLE :** goujon soudés excentrés par rapport à la préparation circulaire. → **Retirer et reposer** le goujon	Centrer la pointe du goujon sur la surface préparée. Maintenir tranquillement l'outil à main FX 3-HT de manière perpendiculaire et centrée.	Tableau A.5, n° 4 de l'EN ISO 14555:2017
3	**Goujon incliné >2°** 		**NON ACCEPTABLE :** goujon incliné >2° → **Retirer et reposer** le goujon	Maintenir fermement l'outil à main de manière perpendiculaire pendant le soudage. S'assurer que la préparation de la surface est parallèle à la surface du matériau de départ.	Tableau A.5, n° 4 de l'EN ISO 14555:2017
4	**Jointure sur un seul côté, soudure protubérante** 		**NON ACCEPTABLE :** soudure sur un seul côté. → **Soumettre à l'essai** le goujon soudé ou le **retirer**	Respecter les exigences relatives à la préparation de la surface figurant au Tableau 2. Respecter les exigences relatives à l'attache de base, au goujon et à l'espacement du bord.	Tableau A.5, n° 4 de l'EN ISO 14555:2017 et point 9.7.1 de l'AWS D1.6/D1.6M: 2017

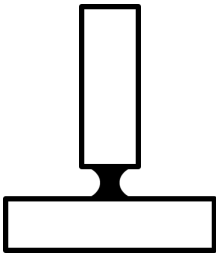
N°	Schémas	Exemples (photos)	Évaluation	Action corrective recommandée	Complémentaire à
5	**Suie autour de la soudure** 		**NON ACCEPTABLE :** le goujon présente de la suie autour de la soudure. → **Soumettre à l'essai** le goujon soudé ou le **retirer**	Respecter les exigences relatives à la préparation de la surface figurant au tableau 3. S'assurer que la préparation de la surface et le goujon sont exempts de contaminants.	Tableau A.5, n° 3 et 4 de l'EN ISO 14555:2017
6	**Éclaboussure ou étincelle** 		**NON ACCEPTABLE :** le goujon présente des éclaboussures ou des étincelles autour de la soudure. → **Soumettre à l'essai** le goujon soudé ou le **retirer**	Respecter les exigences relatives à la préparation de la surface figurant au tableau 3. S'assurer que la préparation de la surface et le goujon sont exempts de contaminants.	Tableau A.5, n° 3 et 5 de l'EN ISO 14555:2017 et point 9.7.1 de l'AWS D1.6/D1.6M: 2017
7	**Diamètre de soudure réduit, partie visible inhabituelle** 		**NON ACCEPTABLE :** goujon avec diamètre réduit ou partie visible inhabituellement haute. → **Retirer et reposer** le goujon	Vérifier le réglage du soudage. Respecter les exigences relatives à la préparation de la surface figurant au tableau 3. S'assurer que la préparation de la surface et le goujon sont exempts de contaminants.	Tableau A.5, n° 2 de l'EN ISO 14555:2017 et point 9.7.1 de l'AWS D1.6/D1.6M: 2017
8	**Code F affiché sur l'outil** 		**NON ACCEPTABLE :** goujons avec code F affiché après la soudure. → **Exécuter les actions demandées au** Tableau 6	Actions correctives selon le code F listées au Tableau 6.	

Tableau 6 : liste des codes F, défauts nécessitant le retrait ou l'inspection du goujon

<table>
<tr><th>Code F</th><th>Défaut</th><th>Action requise</th></tr>
<tr><td>F06</td><td>Mécanique interne de l'outil à main encrassée</td><td rowspan="4">Soit :
Soumettre le goujon à l'essai avec la charge de traction d'épreuve à l'aide du testeur HAT 28 FX.
La charge d'épreuve dépend du code de soudage (code H) du goujon. Si le goujon résiste à la charge d'épreuve, il peut être utilisé. Sinon, il doit être à nouveau posé.
<table><tr><th>Code de soudage (code H)</th><th>Charge de traction d'épreuve en kN (lbf)</th></tr><tr><td>H1</td><td>6 (1350)</td></tr><tr><td>H2</td><td>9 (2025)</td></tr><tr><td>H3</td><td>17 (3820)</td></tr><tr><td>H10</td><td>22 (4950)</td></tr></table>
Soit :
Retirer et poser à nouveau le goujon directement sans le soumettre à l'essai.</td></tr>
<tr><td>F07</td><td>Mauvaise connexion électrique</td></tr>
<tr><td>F10</td><td>Implantation du goujon incorrecte</td></tr>
<tr><td>F14</td><td>Processus interrompu par l'opérateur</td></tr>
<tr><td>F16</td><td>Endroit présentant des contaminants</td><td></td></tr>
<tr><td>F17</td><td>Processus stoppé</td><td>Retirer et poser à nouveau le goujon</td></tr>
</table>

- Afin d'éviter que le code F ne se répète dans les actions correctives, voir l'autocollant dans le boîtier du kit.
- Pour supprimer les défauts liés à des codes F non listés dans ce tableau, voir l'autocollant dans le boîtier du kit.
- Pour savoir comment retirer et poser à nouveau le goujon F-BT, consulter la procédure de réparation des F-BT.

HILTI F-BT − KATALOG FÜR DIE SICHTPRÜFUNG

Der Katalog für die Sichtprüfung der Hilti F-BT Gewindebolzen besteht aus zwei Teilen.

Der erste Teil enthält die Sichtprüfung für die Oberflächenvorbereitung (Tabelle 2 und Tabelle 3) vor der Schweißung, der zweite Teil enthält die Sichtprüfung für die geschweißten Gewindebolzen (Tabelle 4 und Tabelle 5).

Der Katalog für die Sichtprüfung dient zur Bewertung der Schweißung, ob diese annehmbar ist oder nicht.

Dieser Katalog ergänzt die Annahmekriterien für die Sichtprüfung gemäß EN ISO 14555:2017 Tabelle A.5 und AWS D1.6 Absatz 9.7. Er adressiert die Besonderheiten der Hilti F-BT Gewindebolzen basierend auf den Regelungen der genannten Vorschriften.

Der erste Teil hinsichtlich Oberflächenvorbereitung bezieht sich speziell auf die Sichtprüfung bei Verwendung der Hilti FX 3-ST Oberflächenwerkzeuge.

Der Hilti F-BT Katalog für die Sichtprüfung muss sowohl für die Verfahrensprüfung (WPQR) als auch für die Arbeitsprüfungen und die Fertigungsüberwachung im Rahmen der Prozessüberwachung als Bewertungsgrundlage verwendet werden.

Tabelle 1 gibt eine Erklärung zur schematischen Darstellung der Oberflächenvorbereitung und der Gewindebolzen in den folgenden Tabellen.

Tabelle 1: Zeichnungserklärungen

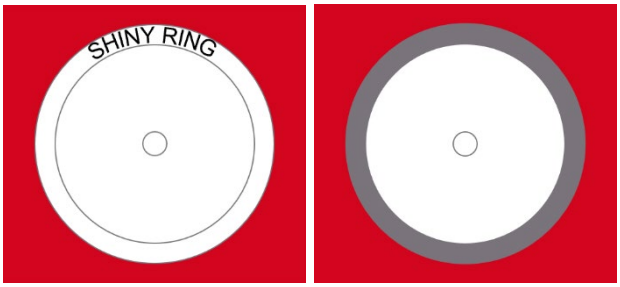
Prinzipskizze	Erklärung
Prüfung der Oberflächenvorbereitung	
	Draufsicht auf die Oberflächenvorbereitung von beschichtetem Grundwerkstoff. Die Farbe der Beschichtung ist in diesem Beispiel rot. Der äußere Ring der vorbereiteten Fläche ist in beiden Skizzen dargestellt. Die linke Skizze zeigt diesen als äußeren blanken "shiny ring". Die rechte Skizze stellt den Ring glanzlos in grau dar und weist damit auf verbliebene Rückstände der Beschichtung hin. Der kleine mittlere Kreis stellt den Eindruck im Grundwerkstoff dar, welcher durch die Spitze des Oberflächenwerkzeuges geformt wird.
Prüfung der geschweißten Gewindebolzen	
	Draufsicht auf einen F-BT Bolzen, geschweißt auf mit dem Oberflächenwerkzeug FX 3-ST d20 vorbereitetem Grundwerkstoff.
	Draufsicht auf einen F-BT Bolzen, geschweißt auf mit dem Oberflächenwerkzeug FX 3-ST d14 vorbereitetem Grundwerkstoff.

Tabelle 2: Oberflächenvorbereitung von beschichtetem Grundwerkstoff mit dem Werkzeug FX 3-ST d20

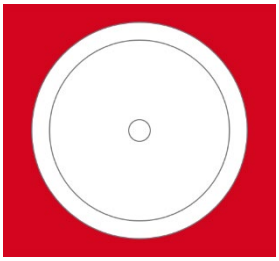
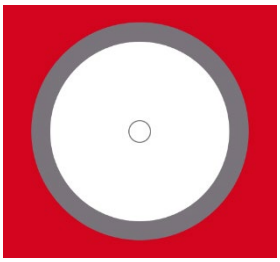
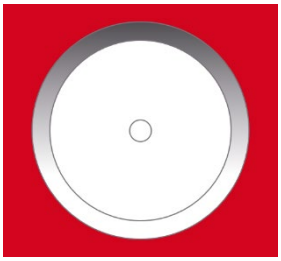
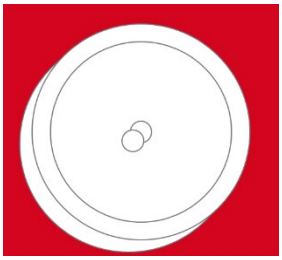
Nr.	Prinzipskizze	Beispielfoto	Bewertung	Empfohlene Korrekturmaßnahmen
1	**Blank mit äußerem „shiny ring“** 		**Annehmbar.**	Keine.
2	**Rückstände auf dem äußeren Ring** 		**Nicht annehmbar.** Rückstände der Beschichtung auf dem äußeren Ring.	Fortsetzen der Oberflächenvorbereitung bis der äußere Ring vollumfänglich sauber und blank ist. Wenn erforderlich, Wechsel des Oberflächenwerkzeuges.
3	**Schräge Oberflächenvorbereitung** 		**Nicht annehmbar.** Schräge Vorbereitung mit einseitig vorhandenen Rückständen der Beschichtung auf dem äußeren Ring.	Fortsetzen der Oberflächenvorbereitung mit Neigen der Bohrmaschine in Richtung der Rückstände, um diese abzuarbeiten und eine ebene Oberfläche herzustellen.
4	**Unebene Oberflächenvorbereitung** 		**Nicht annehmbar.** Rückstände der Beschichtung innerhalb der Fläche.	Fortsetzen der Oberflächenvorbereitung, um diese abzuarbeiten: Zentrisches Anpressen des Bohrwerkzeuges. Taumeln des Werkzeuges vermeiden.
5	**Unsymmetrische oder doppelte Oberflächenvorbereitung** 		**Nicht annehmbar.** Unsymmetrische Vorbereitung mit doppelten Kreisflächen.	Vorbereitung für die Bolzenschweißung nicht geeignet. Herstellung einer neuen Vorbereitung an anderer Stelle erforderlich. Bei der nächsten Vorbereitung auf zentrisches Anpressen und die empfohlene Anpresskraft achten.

Tabelle 3: Oberflächenvorbereitung von unbeschichtetem Grundwerkstoff mit dem Werkzeug FX 3-ST d14

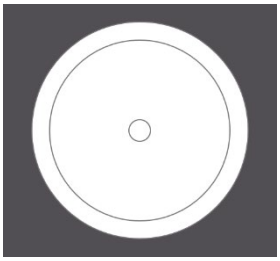
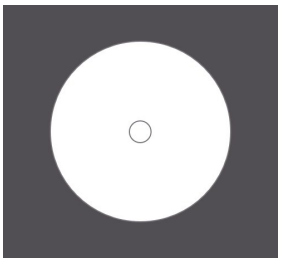
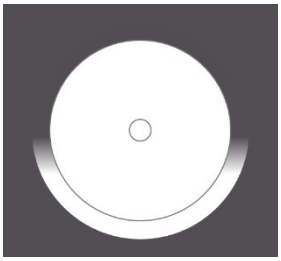
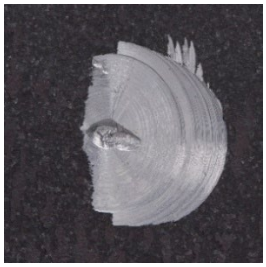
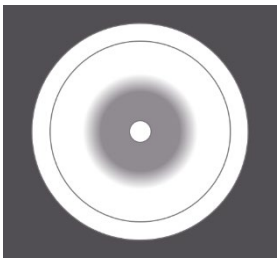
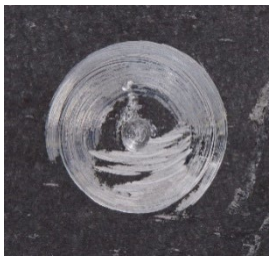
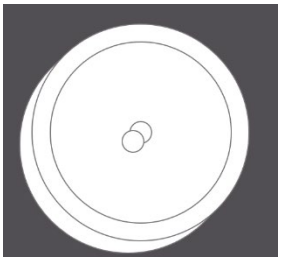
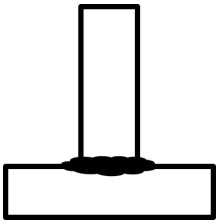
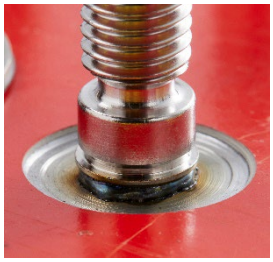
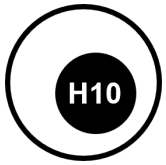
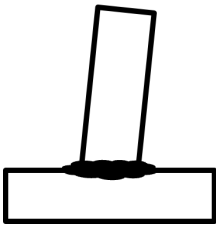
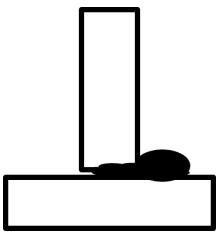
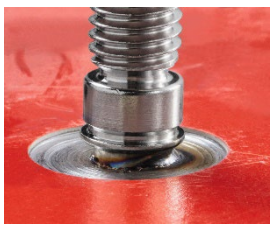
Nr.	Prinzipskizze	Beispielfoto	Bewertung	Empfohlene Korrekturmaßnahmen
1	**Blank mit äußerem „shiny ring“** 		**Annehmbar.**	Keine.
2	**Rückstände auf dem äußeren Ring** 		**Nicht annehmbar.** Rückstände auf dem äußeren Ring.	Fortsetzen der Oberflächenvorbereitung bis der äußere Ring vollumfänglich sauber und blank ist. Wenn erforderlich, Wechsel des Oberflächenwerkzeuges.
3	**Schräge Oberflächenvorbereitung** 		**Nicht annehmbar.** Schräge Vorbereitung mit einseitig vorhandenen Rückständen auf dem äußeren Ring.	Fortsetzen der Oberflächenvorbereitung mit Neigen der Bohrmaschine in Richtung der Rückstände, um diese abzuarbeiten und eine ebene Oberfläche herzustellen.
4	**Unebene Oberflächenvorbereitung** 		**Nicht annehmbar.** Rückstände innerhalb der Fläche.	Fortsetzen der Oberflächenvorbereitung, um diese abzuarbeiten: Zentrisches Anpressen des Bohrwerkzeuges. Taumeln des Werkzeuges vermeiden.
5	**Unsymmetrische oder doppelte Oberflächenvorbereitung** 		**Nicht annehmbar.** Unsymmetrische Vorbereitung mit doppelten Kreisflächen.	Vorbereitung für die Bolzenschweißung nicht geeignet. Herstellung einer neuen Vorbereitung an anderer Stelle erforderlich. Bei der nächsten Vorbereitung auf zentrisches Anpressen und die empfohlene Anpresskraft achten.

Tabelle 4: Katalog zur Sichtprüfung für auf beschichteten Grundwerkstoffen geschweißte F-BT Gewindebolzen (Oberflächenwerkzeug FX 3-ST d20)

Nr.	Prinzipskizze	Beispielfoto	Bewertung	Empfohlene Korrekturmaßnahmen	Ergänzend zu
1	**Gleichmäßig geschlossener Schweißwulst** 		**Annehmbar.**	Keine.	Tabelle A.5, Nr. 4 von EN ISO 14555:2017
2	**Außermittiger Bolzen** 		**Nicht annehmbar.** Bolzen exzentrisch zur Vorbereitung geschweißt. → **Entfernen und neu Schweißung ausführen**	Bolzenspitze in der Mitte der Oberflächenvorbereitung zentrieren. Handgerät FX 3-HT zentrieren, ruhig und senkrecht zur Oberfläche halten.	Tabelle A.5, Nr. 4 von EN ISO 14555:2017
3	**Schräger Bolzen >2°** 		**Nicht annehmbar.** Schräger Bolzen >2°. → **Entfernen und neue Schweißung ausführen**	Handgerät FX 3-HT während Schweißvorgangs fest und senkrecht zur Oberfläche halten. Sicherstellen, dass die Oberflächenvorbereitung parallel zur Oberfläche des Grundwerkstoffes ist.	Tabelle A.5, Nr. 4 von EN ISO 14555:2017
4	**Einseitige Verschweißung, unzulässige Unterschneidung** 		**Nicht annehmbar:** Einseitige Verschweißung. → **Bolzen prüfen oder entfernen**	Katalog zur Sichtprüfung für die Oberflächenvorbereitung gemäß Tabelle 2 einhalten. Anforderungen hinsichtlich Abstands der Masseklemme, Bolzenabstand und Bolzenrandabstand einhalten.	Tabelle A.5, Nr. 4 von EN ISO 14555:2017 Absatz 9.7.1 von AWS D1.6/D1.6M: 2017

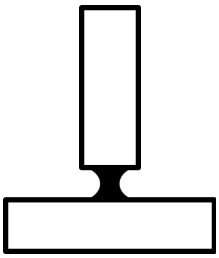
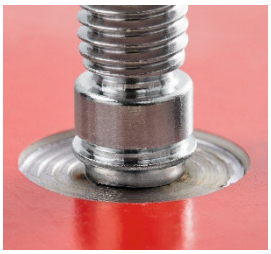
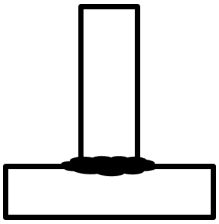
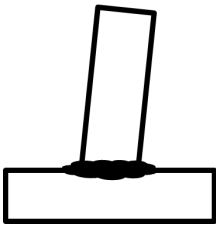
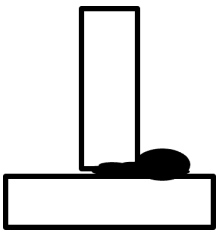
Nr.	Prinzipskizze	Beispielfoto	Bewertung	Empfohlene Korrekturmaßnahmen	Ergänzend zu
5	**Ruß um die Schweißung** 		**Nicht annehmbar.** Bolzen mit Ruß rund um die Schweißung. → **Bolzen prüfen oder entfernen**	Katalog zur Sichtprüfung für die Oberflächenvorbereitung gemäß Tabelle 2 einhalten. Sicherstellen, dass weder Bolzen noch die Oberflächenvorbereitung verunreinigt sind.	Tabelle A.5, Nr. 3 und 4 von EN ISO 14555:2017
6	**Schweißspritzer** 		**Nicht annehmbar.** Bolzen mit Schweißspritzern rund um die Schweißung. → **Bolzen prüfen oder entfernen**	Katalog zur Sichtprüfung für die Oberflächenvorbereitung gemäß Tabelle 2 einhalten. Sicherstellen, dass weder Bolzen noch die Oberflächenvorbereitung verunreinigt sind.	Tabelle A.5, Nr. 3 und 5 von EN ISO 14555:2017 Absatz 9.7.1 von AWS D1.6/D1.6M: 2017
7	**Einschnürung an der Schweißung, zu geringes Eintauchmaß** 		**Nicht annehmbar.** Bolzen mit Einschnürung an der Schweißung oder zu geringem Eintauchmaß. → **Entfernen und neue Schweißung ausführen**	Schweißprogramm (H-Code) überprüfen. Katalog zur Sichtprüfung für die Oberflächenvorbereitung gemäß Tabelle 2 einhalten. Sicherstellen, dass weder Bolzen noch die Oberflächenvorbereitung verunreinigt sind.	Tabelle A.5, Nr. 2 von EN ISO 14555:2017 Absatz 9.7.1 von AWS D1.6/D1.6M: 2017
8	**Anzeige von F-Codes am Schweißgerät** 		**Nicht annehmbar.** Bolzen mit F-Code Anzeige am Schweißgerät. → **Maßnahmen gemäß Tabelle 6 einhalten**	Korrekturmaßnahmen in Abhängigkeit vom angezeigten F-Code gemäß Tabelle 6 einhalten.	

Tabelle 5: Katalog zur Sichtprüfung für auf unbeschichteten Grundwerkstoffen geschweißte F-BT Gewindebolzen (Oberflächenwerkzeug FX 3-ST d14)

Nr.	Prinzipskizze	Beispielfoto	Bewertung	Empfohlene Korrekturmaßnahmen	Ergänzend zu
1	**Gleichmäßig geschlossener Schweißwulst** 		**Annehmbar.**	Keine.	Tabelle A.5, Nr. 4 von EN ISO 14555:2017
2	**Außermittiger Bolzen** 		**Nicht annehmbar:** Bolzen exzentrisch zur Vorbereitung geschweißt. → **Entfernen und neue Schweißung ausführen**	Bolzenspitze in der Mitte der Oberflächenvorbereitung zentrieren. Handgerät FX 3-HT zentrieren, ruhig und senkrecht zur Oberfläche halten.	Tabelle A.5, Nr. 4 von EN ISO 14555:2017
3	**Schräger Bolzen >2°** 		**Nicht annehmbar:** Schräger Bolzen >2°. → **Entfernen und neue Schweißung ausführen**	Handgerät FX 3-HT während Schweißvorgangs fest und senkrecht zur Oberfläche halten. Sicherstellen, dass die Oberflächenvorbereitung parallel zur Oberfläche des Grundwerkstoffes ist.	Tabelle A.5, Nr. 4 von EN ISO 14555:2017
4	**Einseitige Verschweißung, unzulässige Unterschneidung** 		**Nicht annehmbar:** Einseitige Verschweißung. → **Bolzen prüfen oder entfernen**	Katalog zur Sichtprüfung für die Oberflächenvorbereitung gemäß Tabelle 3 einhalten. Anforderungen hinsichtlich Abstands der Masseklemme, Bolzenabstand und Bolzenrandabstand einhalten.	Tabelle A.5, Nr. 4 von EN ISO 14555:2017 Absatz 9.7.1 von AWS D1.6/D1.6M: 2017

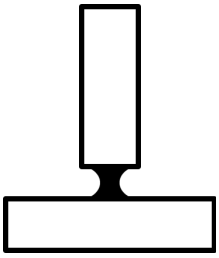
Nr.	Prinzipskizze	Beispielfoto	Bewertung	Empfohlene Korrekturmaßnahmen	Ergänzend zu
5	**Ruß um die Schweißung** 		**Nicht annehmbar.** Bolzen mit Ruß rund um die Schweißung. → **Bolzen prüfen oder entfernen**	Katalog zur Sichtprüfung für die Oberflächenvorbereitung gemäß Tabelle 3 einhalten. Sicherstellen, dass weder Bolzen noch die Oberflächenvorbereitung verunreinigt sind.	Tabelle A.5, Nr. 3 und 4 von EN ISO 14555:2017
6	**Schweißspritzer** 		**Nicht annehmbar.** Bolzen mit Schweißspritzern um die Schweißung herum. → **Bolzen prüfen oder entfernen**	Katalog zur Sichtprüfung für die Oberflächenvorbereitung gemäß Tabelle 3 einhalten. Sicherstellen, dass weder Bolzen noch die Oberflächenvorbereitung verunreinigt sind.	Tabelle A.5, Nr. 3 und 5 von EN ISO 14555:2017 Absatz 9.7.1 von AWS D1.6/D1.6M: 2017
7	**Einschnürung an der Schweißung, zu geringes Eintauchmaß** 		**Nicht annehmbar.** Bolzen mit Einschnürung an der Schweißung oder zu geringem Eintauchmaß. → **Entfernen und neue Schweißung ausführen**	Schweißprogramm (H-Code) überprüfen. Katalog zur Sichtprüfung für die Oberflächenvorbereitung gemäß Tabelle 3 einhalten. Sicherstellen, dass weder Bolzen noch die Oberflächenvorbereitung verunreinigt sind.	Tabelle A.5, Nr. 2 von EN ISO 14555:2017 Absatz 9.7.1 von AWS D1.6/D1.6M: 2017
8	**Anzeige von F-Codes am Schweißgerät** 		**Nicht annehmbar.** Bolzen mit F-Code Anzeige am Schweißgerät. → **Maßnahmen gemäß Tabelle 6 einhalten**	Korrekturmaßnahmen in Abhängigkeit vom angezeigten F-Code gemäß Tabelle 6 einhalten.	

Tabelle 6: Liste der Fehler (F-Codes), die eine Prüfung oder Entfernung des Gewindebolzens erfordern

<table>
<tr><th>Störung</th><th>Mögliche Ursache</th><th>Erforderliche Maßnahme</th></tr>
<tr><td>F06</td><td>Innere Mechanik des Handgerätes schwergängig</td><td rowspan="4">Entweder:
Durchführung einer nicht zerstörenden Zugprüfung mit dem Prüfgerät HAT 28 FX.
Die Zugprüflast hängt vom Schweißprogramm (H-Code) des jeweiligen Bolzens ab. Kann die Zugprüflast ohne Beschädigung des Bolzens aufgebracht werden, darf dieser verwendet werden, ansonsten ist dieser Bolzen zu entfernen und neu zu schweißen.
<table><tr><th>Schweißprogramm (H-Code)</th><th>Zugprüflast kN (lbf)</th></tr><tr><td>H1</td><td>6 (1350)</td></tr><tr><td>H2</td><td>9 (2025)</td></tr><tr><td>H3</td><td>17 (3820)</td></tr><tr><td>H10</td><td>22 (4950)</td></tr></table>
oder:
Bolzen entfernen und neue Schweißung ausführen.</td></tr>
<tr><td>F07</td><td>Unzureichender elektrischer Kontakt</td></tr>
<tr><td>F10</td><td>Schweißfehler, zu geringes oder zu tiefes Eintauchmaß</td></tr>
<tr><td>F14</td><td>Abbruch des Schweißvorganges durch vorzeitiges Lösen des Auslösers oder durch Abziehen des Handgerätes.</td></tr>
<tr><td>F16</td><td>Werkstück oder Bolzen sind im Schweißbereich verunreinigt.</td><td></td></tr>
<tr><td>F17</td><td>Abbruch des Schweißvor ganges.</td><td>Bolzen entfernen und neue Schweißung ausführen.</td></tr>
</table>

- Um wiederholtes Auftreten von Störungen zu vermeiden, die Anleitungen auf dem Aufkleber im Inneren des Koffers des Akku-Schweißgerätes beachten.
- Zur Behebung von Störungen zu hier nicht aufgelisteten F-Codes siehe den Aufkleber im Inneren des Koffers des Akku-Schweißgerätes.
- Empfehlungen zum Entfernen von F-BT Bolzen und anschließender Neuverschweißung gemäß der Reparaturanleitung für die F-BT Gewindebolzen.

हिल्टी एफ-BT दृश्य परीक्षा सूची

हिल्टी एफ-BT स्टड के लिए दृश्य परीक्षा और मूल्यांकन दो भागों में विभाजित है।

सबसे पहले, वेल्डिंग से पहले सतह की तैयारी (तालिका 2 और तालिका 3) की जाँच और दूसरी, एफ-BT स्टड वेल्डिंग के लिए ही जाँच (तालिका 4 और तालिका 5)।

परीक्षा सूची का उद्देश्य उपयोग के लिए स्वीकार्य या अस्वीकार्य के रूप में दृश्य उपस्थिति का आकलन करना है।

स्टड की उपस्थिति के मानदंड EN ISO 14555:2017 तालिका A.5 और AWS D1.6 खंड 9.7 की आवश्यकताओं के पूरक हैं। इन मानकों को आधार के रूप में उपयोग करते हुए, यह दस्तावेज़ हिल्टी एफ-BT वेल्डेड स्टड की बारीकियों को संबोधित करता है।

सतह की तैयारी के लिए परीक्षा सूची विशेष रूप से हिल्टी FX 3-ST सतह उपकरणों का उपयोग करके पूरी की गई तैयारियों की उपस्थिति के लिए स्थापित की गई है।

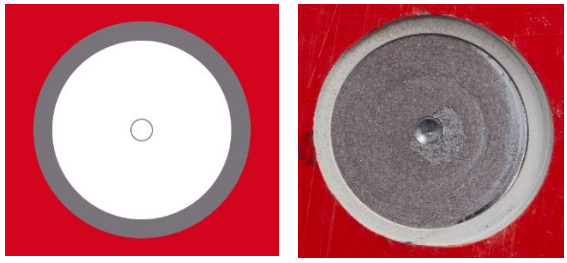
हिल्टी एफ-BT परीक्षा सूची का उपयोग वेल्डिंग प्रक्रिया योग्यता रिकॉर्ड (WPQR/PQR) के साथ-साथ प्रक्रिया नियंत्रण, उत्पादन वेल्डिंग नियंत्रण और उत्पादन निगरानी के दौरान स्टड परीक्षा के लिए किया जाएगा।

तालिका 1 इस सूची में उपयोग किए गए योजनाबद्ध रेखाचित्रों को पढ़ने के तरीके का विवरण प्रदान करती है।

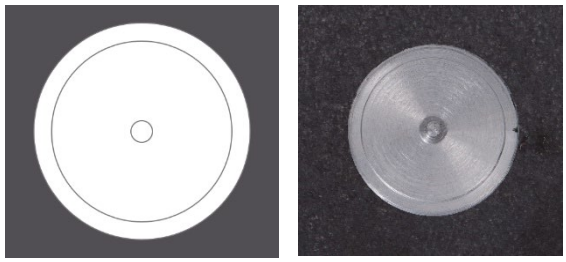
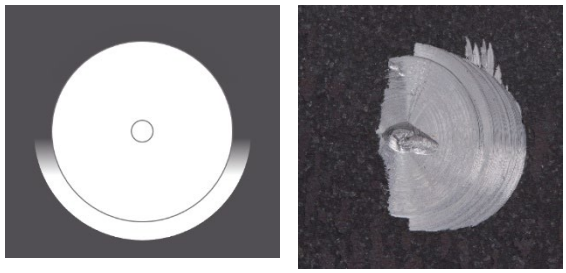
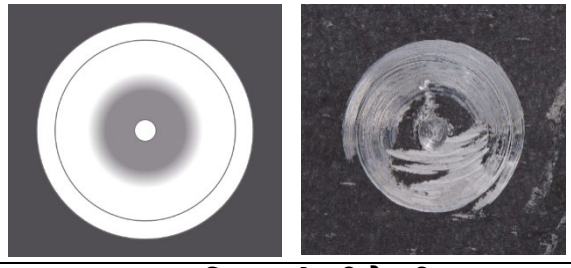
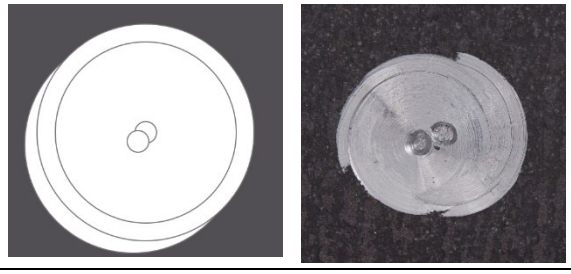
तालिका 1: स्कीमेटिक्स स्पष्टीकरण

स्कीमेटिक	स्पष्टीकरण
सतह तैयारी परीक्षा	
	लेपित स्टील पर सतह की तैयारी का ऊपर से नीचे का दृश्य। इस उदाहरण में लेप का रंग लाल है। दोनों स्कीमेटिक्स में एक बाहरी रिंग दिखाया गया है। बायां स्कीमेटिक बाहर की तरफ एक "चमकदार रिंग" दिखाता है। जबकि सही स्कीमेटिक एक छल्ला दिखाता है जिसमें अवशेष होते हैं, जो अधिक सुस्त रंग होगा। प्रत्येक स्कीमेटिक के केंद्र में छोटा वृत्त सतह उपकरण के केंद्र सिरे द्वारा गठित इंडेंटेशन का प्रतिनिधित्व करता है।
वेल्डेड स्टड का परीक्षण	
	FX 3-ST d20 सतह उपकरण के साथ तैयार की गई मूल सामग्री से वेल्डेड एफ-BT का टॉप-डाउन दृश्य।
	FX 3-ST d14 सतह उपकरण के साथ तैयार की गई मूल सामग्री से वेल्डेड एफ-BT का टॉप-डाउन दृश्य।

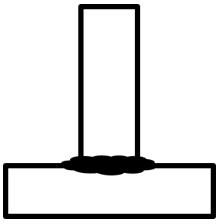
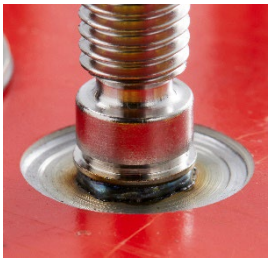
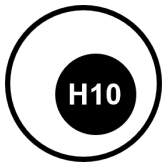
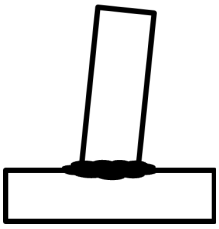
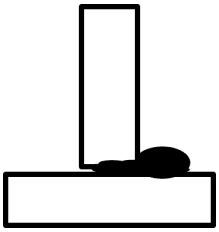
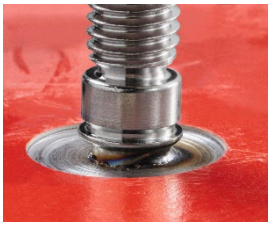
तालिका 2: सतह उपकरण FX 3-ST d20 के साथ लेपित मूल सामग्री की सतह की तैयारी

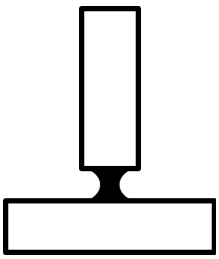
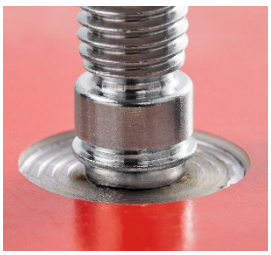
ना	स्कीमेटिक्स	उदाहरण छवी	मूल्यांकन	संस्तुत सुधारात्मक कार्रवाई
1	**खाली और चमकदार रिंग**		**स्वीकार्य**	कोई भी नहीं
2	**बाहरी रिंग पर अवशेष**		**स्वीकार्य नहीं है:** बाहरी रिंग पर अवशेष.	तैयारी की प्रक्रिया तब तक जारी रखें जब तक कि स्टॉप शोल्डर (बाहरी रिंग) 360° के आसपास साफ न हो जाए। जरूरत पड़ने पर सरफेस टूल बदलें।
3	**झूकी हुई सतह तैयारी**		**स्वीकार्य नहीं है:** एक तरफा अवशेष और झूकी हुई तैयारी।	तैयारी की प्रक्रिया जारी रखें और ड्रिलिंग मशीन को थोड़ा उस तरफ झुकाएं, जहां अवशेष उन्हें हटाने और स्टड स्थापना के लिए एक समान सतह प्रदान करने के लिए पाए जाते हैं।
4	**असमान तैयारी**		**स्वीकार्य नहीं है:** सतह पर अवशेष:	सतह तैयार करते समय टूल को सीधे सतह पर पकड़ें और दबाएं। सतह के उपकरण के डगमगाने से बचें।
5	**असममित या दोगुनी तैयारी**		**स्वीकार्य नहीं है:** एक दोहरा वृत्त दिखाते हुए एक असममित तैयारी।	वेल्डिंग के लिए असममित तैयारी का उपयोग न करें। एक नए स्थान पर तैयारी बनाएँ। अगली बार तैयारी प्रक्रिया के दौरान टूल को सीधा और मजबूती से दबाकर रखें।

तालिका 3: सतह उपकरण FX 3-ST d14 के साथ लेपित मूल सामग्री की सतह की तैयारी

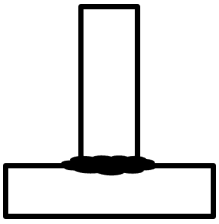
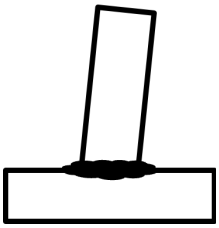
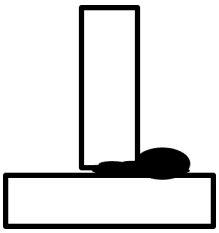
ना	स्कीमेटिक्स	उदाहरण छवी	मूल्यांकन	संस्तुत सुधारात्मक कार्रवाई
1	**खाली और चमकदार रिंग**		**स्वीकार्य**	कोई भी नहीं
2	**बाहरी रिंग पर अवशेष**		**स्वीकार्य नहीं है:** बाहरी रिंग पर अवशेष.	तैयारी की प्रक्रिया तब तक जारी रखें जब तक कि स्टॉप शोल्डर (बाहरी रिंग) 360° के आसपास साफ न हो जाए। जरूरत पड़ने पर सरफेस टूल बदलें।
3	**झूकी हुई सतह तैयारी**		**स्वीकार्य नहीं है:** एक तरफा अवशेष और झूकी हुई तैयारी।	तैयारी की प्रक्रिया जारी रखें और ड्रिलिंग मशीन को थोड़ा उस तरफ झुकाएं, जहां अवशेष उन्हें हटाने और स्टड स्थापना के लिए एक समान सतह प्रदान करने के लिए पाए जाते हैं।
4	**असमान तैयारी**		**स्वीकार्य नहीं है:** सतह पर अवशेष:	सतह तैयार करते समय टूल को सीधे सतह पर पकड़ें और दबाएं। सतह के उपकरण के डगमगाने से बचें।
5	**असममित या दोगुनी तैयारी**		**स्वीकार्य नहीं है:** असममित या दोगुनी तैयारी.	वेल्डिंग के लिए असममित तैयारी का उपयोग न करें। एक नए स्थान पर तैयारी बनाएँ। अगली बार तैयारी प्रक्रिया के दौरान टूल को सीधा और मजबूती से दबाकर रखें।

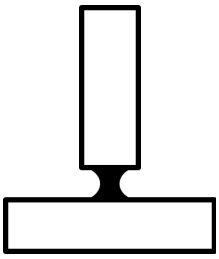
तालिका 4: लेपित स्टील पर वेल्डेड एफ-बीटी स्टड के लिए दृश्य परीक्षा सूची (सरफेस टूल FX 3-ST d20)

ना	स्कीमेटिक्स	उदाहरण छवी	मूल्यांकन	संस्तुत सुधारात्मक कार्रवाई	के पूरक
1	**नियमत एवं पूर्ण कॉलर** 		**स्वीकार्य**	कोई भी नहीं।	EN ISO 14555:2017 की तालिका A.5, संख्या 4
2	**केंद्रभ्रष्ट स्टड** 		**स्वीकार्य नहीं है:** स्टड्स को केंद्रभ्रष्ट वृत्ताकार तैयारी के लिए वेल्डे किया। → स्टड **निकालें और पुनः स्थापित क**रें	स्टड की नोक को सतह की तैयारी के मध्य में केन्द्रित करें। हैंड टूल FX 3-HT को केंद्रित, लंबवत और शांत रखें।	EN ISO 14555:2017 की तालिका A.5, संख्या 4
3	**झूका हुआ स्टड >2°** 		**स्वीकार्य नहीं है:** झूका हुआ स्टड >2°. → स्टड **निकालें और पुनः स्थापित क**रें	वेल्डिंग के दौरान हाथ उपकरण को लंबवत और दृढ़ रखें। आश्वासन दें कि सतह की तैयारी मूल सामग्री की सतह के समानांतर है।	EN ISO 14555:2017 की तालिका A.5, संख्या 4
4	**एक तरफा कनेक्शन, वेल्ड ड्रॉप फैला हुआ** 		**स्वीकार्य नहीं है:** एक तरफा वेल्ड कनेक्शन → वेल्डेड स्टड का **परीक्षण करें या दूर करें**	तालिका 2 में सतह की तैयारी आवश्यकताओं का अनुपालन करें. बेस क्लैम्प, स्टड और एज स्पेसिंग आवश्यकताओं का अनुपालन करें।	EN ISO 14555:2017 की तालिका A.5, संख्या 4 और AWS D1.6/D1.6M का खंड 9.7.1: 2017

ना	स्कीमेटिक्स	उदाहरण छवी	मूल्यांकन	संस्तुत सुधारात्मक कार्रवाई	के पूरक
5	**वेल्ड के आसपास कालिख** 		**स्वीकार्य नहीं है:** वेल्ड के चारों ओर कालिख वाले स्टड। → वेल्डेड स्टड का **परीक्षण करें या दूर करें**	में सतह की तैयारी आवश्यकताओं का अनुपालन करें तालिका 2. सुनिश्चित करें कि सतह की तैयारी और स्टड किसी भी संदूषण से मुक्त हैं।	तालिका A.5, का नं. 3 और 4 EN ISO 14555:2017
6	**छींटे या चिंगारी** 		**स्वीकार्य नहीं है:** वेल्ड के चारों ओर छींटे या चिंगारी वाले स्टड। → वेल्डेड स्टड का **परीक्षण करें या दूर करें**	में सतह की तैयारी आवश्यकताओं का अनुपालन करें तालिका 2. सुनिश्चित करें कि सतह की तैयारी और स्टड किसी भी संदूषण से मुक्त हैं।	तालिका A.5, का नं. 3 और 5 EN ISO 14555:2017 और AWS D1.6/D1.6M का खंड 9.7.1: 2017
7	**वेल्ड व्यास कम, असामान्य स्टैंड ऑफ** 		**स्वीकार्य नहीं है:** कम व्यास या असामान्य उच्च स्टैंड-ऑफ वाले स्टड। → स्टड **निकालें और पुनः स्थापित क**रें	वेल्ड कोड की जाँच करें (एच-कोड) सेटिंग। में सतह की तैयारी आवश्यकताओं का अनुपालन करें तालिका 2. सुनिश्चित करें कि सतह की तैयारी और स्टड किसी भी संदूषण से मुक्त हैं।	EN ISO 14555:2017 की तालिका A.5, संख्या 2 और और AWS D1.6/D1.6M का खंड 9.7.1: 2017
8	**उपकरण पर प्रदर्शित एफ-कोड** 		**स्वीकार्य नहीं है:** वेल्ड के बाद प्रदर्शित एफ-कोड वाले स्टड। → तालिका 6**में आवश्यक क्रियाओं का पालन करें**	तालिका 6 में सूचीबद्ध एफ-कोड के आधार पर सुधारात्मक कार्रवाइयाँ.	

तालिका 5: लेपित स्टील पर वेल्डेड एफ-बीटी स्टड के लिए दृश्य परीक्षा सूची (सरफेस टूल FX 3-ST d14)

ना	स्कीमेटिक्स	उदाहरण छवी	मूल्यांकन	संस्तुत सुधारात्मक कार्रवाई	के पूरक
1	**वेल्ड पिन के चारों ओर नियमित पूर्ण कॉलर** 		**स्वीकार्य**	कोई भी नहीं।	EN ISO 14555:2017 की तालिका A.5, संख्या 4
2	**केंद्रभ्रष्ट स्टड** 		**स्वीकार्य नहीं है:** स्टड्स को केंद्रभ्रष्ट वृत्ताकार तैयारी के लिए वेल्डे किया। → स्टड **निकालें और पुनः स्थापित क**रें	स्टड की नोक को सतह की तैयारी के मध्य में केन्द्रित करें। हैंड टूल FX 3-HT को केंद्रित, लंबवत और शांत रखें।	EN ISO 14555:2017 की तालिका A.5, संख्या 4
3	**झूका हुआ स्टड >2°** 		**स्वीकार्य नहीं है:** झूका हुआ स्टड >2°. → स्टड **निकालें और पुनः स्थापित क**रें	वेल्डिंग के दौरान हाथ उपकरण को लंबवत और दृढ़ रखें। आश्वासन दें कि सतह की तैयारी मूल सामग्री की सतह के समानांतर है।	EN ISO 14555:2017 की तालिका A.5, संख्या 4
4	**एक तरफा कनेक्शन, वेल्ड ड्रॉप फैला हुआ** 		**स्वीकार्य नहीं है:** एक तरफा वेल्ड कनेक्शन → वेल्डेड स्टड का **परीक्षण करें या दूर करें**	तालिका 2 में सतह की तैयारी आवश्यकताओं का अनुपालन करें. बेस क्लैम्प, स्टड और एज स्पेसिंग आवश्यकताओं का अनुपालन करें।	EN ISO 14555:2017 की तालिका A.5, संख्या 4 और और AWS D1.6/D1.6M का खंड 9.7.1: 2017

ना	स्कीमेटिक्स	उदाहरण छवी	मूल्यांकन	संस्तुत सुधारात्मक कार्रवाई	के पूरक
5	**वेल्ड के आसपास कालिख** 		**स्वीकार्य नहीं है:** वेल्ड के चारों ओर कालिख वाले स्टड। → वेल्डेड स्टड का **परीक्षण करें या दूर करें**	तालिका 3 में सतह की तैयारी आवश्यकताओं का अनुपालन करें. सुनिश्चित करें कि सतह की तैयारी और स्टड किसी भी संदूषण से मुक्त हैं।	तालिका A.5, का नं. 3 और 4 EN ISO 14555:2017
6	**छींटे या चिंगारी** 		**स्वीकार्य नहीं है:** वेल्ड के चारों ओर छींटे या चिंगारी वाले स्टड। → वेल्डेड स्टड का **परीक्षण करें या दूर करें**	तालिका 3 में सतह की तैयारी आवश्यकताओं का अनुपालन करें. सुनिश्चित करें कि सतह की तैयारी और स्टड किसी भी संदूषण से मुक्त हैं।	तालिका A.5, का नं. 3 और 5 EN ISO 14555:2017 और और AWS D1.6/D1.6M का खंड 9.7.1: 2017
7	**वेल्ड व्यास कम, असामान्य स्टैंड ऑफ** 		**स्वीकार्य नहीं है:** कम व्यास या असामान्य उच्च स्टैंड-ऑफ वाले स्टड। → स्टड **निकालें और पुनः स्थापित करें**	वेल्ड कोड की जाँच करें (एच-कोड सेटिंग। तालिका 3 में सतह की तैयारी आवश्यकताओं का अनुपालन करें. सुनिश्चित करें कि सतह की तैयारी और स्टड किसी भी संदूषण से मुक्त हैं।	EN ISO 14555:2017 की तालिका A.5, संख्या 2 और और AWS D1.6/D1.6M का खंड 9.7.1: 2017
8	**उपकरण पर प्रदर्शित एफ-कोड** 		**स्वीकार्य नहीं है:** वेल्ड के बाद प्रदर्शित एफ-कोड वाले स्टड। → तालिका 6में आवश्यक क्रियाओं का पालन करें	तालिका 6 में सूचीबद्ध एफ-कोड के आधार पर सुधारात्मक कार्रवाइयाँ.	

तालिका 6: एफ-कोड सूचि, असफल मामले में स्टड को हटाने या निरीक्षण की आवश्यकता होती है

<table>
<tr><th>एफ-कोड</th><th>असफल मामला</th><th>आवश्यक क्रिया</th></tr>
<tr><td>F06</td><td>हाथ उपकरण आंतरिक यांत्रिकी चिपचिपा</td><td rowspan="4">दोनों में से एक:
HAT 28 FX के साथ स्टड को टेन्साइल प्रूफ लोड पर टेस्ट करें।
प्रूफ लोड स्टड के वेल्ड कोड (एच-कोड) पर निर्भर करता है। यदि स्टड प्रूफ लोड झेल सकता है, तो इसका उपयोग किया जाना अच्छा है, अन्यथा इसे फिर से स्थापित किया जाएगा।
<table><tr><th>वेल्ड कोड (एच-कोड)</th><th>kN (lbf) में टेन्साइल प्रूफ लोड</th></tr><tr><td>H1</td><td>6 (1350)</td></tr><tr><td>H2</td><td>9 (2025)</td></tr><tr><td>H3</td><td>17 (3820)</td></tr><tr><td>H10</td><td>22 (4950)</td></tr></table>या:
परीक्षण के बिना स्टड को सीधे निकालें और पुनः स्थापित करें।</td></tr>
<tr><td>F07</td><td>विद्युत कनेक्शन खराब</td></tr>
<tr><td>F10</td><td>स्टड एम्बेडिंग उचित नहीं है</td></tr>
<tr><td>F14</td><td>ऑपरेटर ने प्रक्रिया बाधित की</td></tr>
<tr><td>F16</td><td>स्पॉट दूषित</td><td>स्टड निकालें और पुनः स्थापित करें</td></tr>
<tr><td>F17</td><td>प्रक्रिया छोड़ी गई</td><td></td></tr>
</table>

- एफ-कोड की बार-बार होने वाली घटना से बचने के लिए सुधारात्मक कार्रवाई के लिए किट बॉक्स के अंदर स्टिकर देखें।
- एफ-कोड की समस्या निवारण के लिए यहां सूचीबद्ध नहीं है, किट बॉक्स के अंदर स्टिकर देखें।
- एफ-BT को हटाने और पुनः स्थापित करने के बारे में सिफारिश एफ-BT की मरम्मत प्रक्रिया में पाई जा सकती है।

KATALOG PEMERIKSAAN VISUAL HILTI F-BT

Pemeriksaan dan penilaian visual terhadap stad Hilti F-BT terbahagi kepada dua bahagian.

Pertama, pemeriksaan penyediaan permukaan (Jadual 2 dan Jadual 3) sebelum pengimpalan dan kedua, pemeriksaan untuk pengimpalan stad F-BT itu sendiri (Jadual 4 dan Jadual 5).

Tujuan katalog pemeriksaan adalah untuk menilai penampilan visual sebagai boleh diterima atau tidak boleh diterima untuk digunakan.

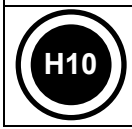
Kriteria untuk penampilan stad adalah saling melengkapi kepada keperluan EN ISO 14555:2017 Jadual A.5 dan AWS D1.6 Fasal 9.7. Dengan menggunakan piawaian ini sebagai asas, dokumen ini menangani spesifikasi stad Hilti F-BT yang dikimpal.

Katalog pemeriksaan untuk penyediaan permukaan diwujudkan secara eksklusif untuk penampilan penyediaan yang dilengkapkan menggunakan alat permukaan Hilti FX 3-ST.

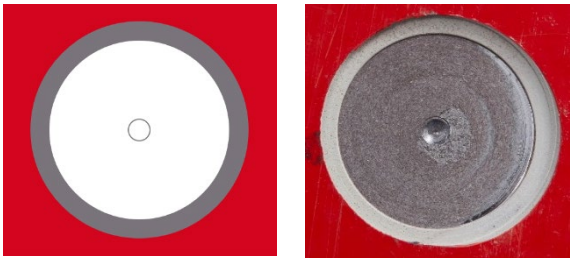
Katalog pemeriksaan Hilti F-BT hendaklah digunakan untuk rekod kelayakan prosedur kimpalan (WPQR/PQR) serta untuk pemeriksaan stad semasa kawalan proses, kawalan kimpalan pengeluaran dan pengawasan pengeluaran.

Jadual 1 memberikan penerangan tentang cara membaca lakaran skema yang digunakan dalam katalog ini.

Jadual 1: Penerangan skema

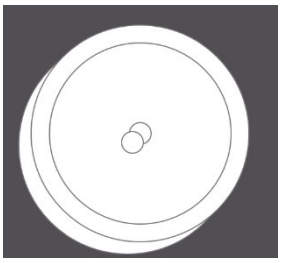
Skema	Penerangan
Pemeriksaan penyediaan permukaan	
	Pandangan dari atas ke bawah penyediaan permukaan pada keluli bersalut. Warna salutan adalah merah dalam contoh ini. Dalam kedua-dua skema, gelang luar ditunjukkan. Skema kiri menunjukkan "gelang berkilat" di bahagian luar. Manakala skema kanan menunjukkan gelang yang mempunyai sisa, yang akan menjadi warna yang lebih kusam. Bulatan kecil di bahagian tengah setiap skema mewakili lekuk yang dibentuk oleh hujung tengah alat permukaan.
Pemeriksaan stad yang dikimpal	
	Pandangan dari atas ke bawah F-BT yang dikimpal pada bahan induk yang disediakan dengan alat permukaan FX 3-ST d20.
	Pandangan dari atas ke bawah F-BT yang dikimpal pada bahan induk yang disediakan dengan alat permukaan FX 3-ST d14.

Jadual 2: Penyediaan permukaan bahan induk bersalut dengan alat permukaan FX 3-ST d20

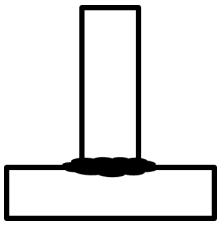
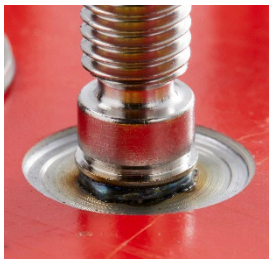
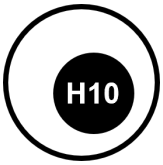
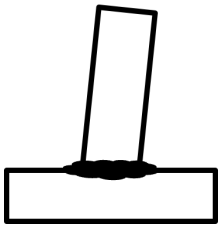
Nombor	Skema	Imej contoh	Penilaian	Tindakan pembetulan yang disyorkan
1	**Gelang kosong dan berkilat**		**BOLEH DITERIMA**	Tiada
2	**Sisa pada gelang luar**		**TIDAK BOLEH DITERIMA:** Sisa pada gelang luar.	Teruskan proses penyediaan sehingga bahu henti (gelang luar) bersih 360° di sekelilingnya. Tukar alat permukaan jika perlu.
3	**Permukaan penyediaan condong**		**TIDAK BOLEH DITERIMA:** Sisa satu sisi dan penyediaan condong.	Teruskan proses penyediaan dan sengetkan mesin penggerudian sedikit ke sisi, bagi mengeluarkan sisa yang terdapat di situ dan menyediakan permukaan yang rata untuk pemasangan stad.
4	**Penyediaan yang tidak sekata**		**TIDAK BOLEH DITERIMA:** Sisa pada permukaan.	Pegang dan tekan alat tegak ke permukaan ketika menyediakan permukaan. Elakkan daripada menggoyangkan alat permukaan.
5	**Penyediaan tak simetri atau berganda**		**TIDAK BOLEH DITERIMA:** Penyediaan tak simetri yang menunjukkan bulatan berganda.	Jangan gunakan penyediaan tak simetri untuk pengimpalan. Buat penyediaan di lokasi baharu. Pada kali seterusnya, pegang dan tekan alat dengan tegak dan kuat semasa proses penyediaan.

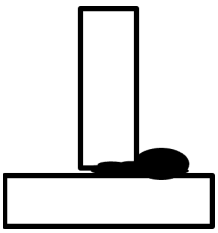
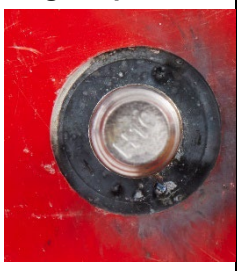
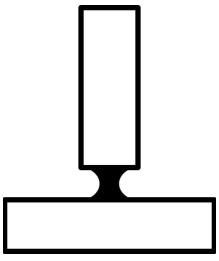
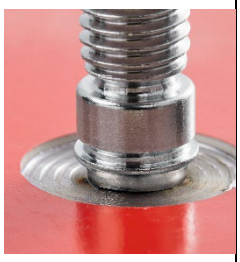
Jadual 3: Penyediaan permukaan bahan induk tidak bersalut dengan alat permukaan FX 3-ST d14

Nombor	Skema	Imej contoh	Penilaian	Tindakan pembetulan yang disyorkan
1	**Gelang kosong dan berkilat**		**BOLEH DITERIMA**	Tiada
2	**Sisa pada gelang luar**		**TIDAK BOLEH DITERIMA:** Sisa pada gelang.	Teruskan proses penyediaan sehingga bahu henti (gelang luar) bersih 360° di sekelilingnya. Tukar alat permukaan jika perlu.
3	**Permukaan penyediaan condong**		**TIDAK BOLEH DITERIMA:** Sisa satu sisi dan penyediaan condong.	Teruskan proses penyediaan dan sengetkan mesin penggerudian sedikit ke sisi, bagi mengeluarkan sisa yang terdapat di situ dan menyediakan permukaan yang rata untuk pemasangan stad.
4	**Penyediaan yang tidak sekata**		**TIDAK BOLEH DITERIMA:** Sisa pada permukaan.	Pegang dan tekan alat tegak ke permukaan ketika menyediakan permukaan. Elakkan daripada menggoyangkan alat permukaan.

Nombor	Skema	Imej contoh	Penilaian	Tindakan pembetulan yang disyorkan
5	**Penyediaan tak simetri atau berganda** 		**TIDAK BOLEH DITERIMA:** Penyediaan tak simetri atau berganda.	Jangan gunakan penyediaan tak simetri untuk pengimpalan. Buat penyediaan di lokasi baharu. Pada kali seterusnya, pegang dan tekan alat dengan tegak dan kuat semasa proses penyediaan.

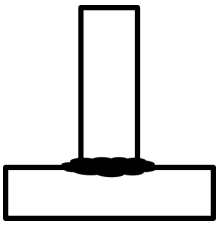
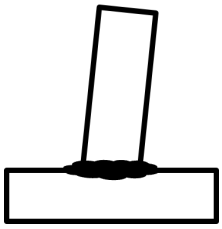
Jadual 4: Katalog pemeriksaan visual untuk stad F-BT yang dikimpal pada keluli bersalut (permukaan alat FX 3-ST d20)

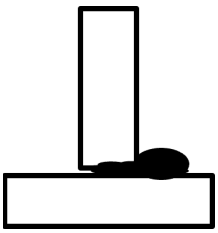
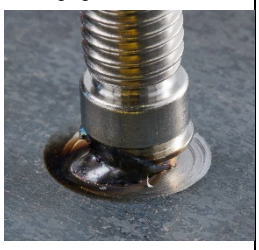
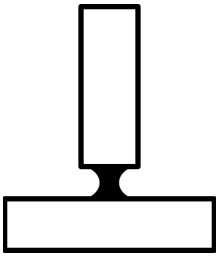
Nombor	Skema	Imej contoh	Penilaian	Tindakan pembetulan yang disyorkan	Pelengkap kepada
1	**Kolar biasa dan lengkap** 		**BOLEH DITERIMA**	Tiada.	Jadual A.5, Nombor 4 EN ISO 14555:2017
2	**Stad sipi** 		**TIDAK BOLEH DITERIMA:** Stad yang dikimpal sipi kepada penyediaan membulat. → **Tanggalkan dan pasang semula** stad	Letakkan hujung stad pada bahagian tengah di pertengahan penyediaan permukaan. Pegang alat tangan FX 3-HT dengan berpusat, serenjang dan tenang.	Jadual A.5, Nombor 4 EN ISO 14555:2017
3	**Stad condong >2°** 		**TIDAK BOLEH DITERIMA:** Stad condong >2°. → **Tanggalkan dan pasang semula** stad	Pegang alat tangan dengan serenjang dan kuat semasa mengimpal. Pastikan bahawa penyediaan permukaan adalah selari dengan permukaan bahan induk.	Jadual A.5, Nombor 4 EN ISO 14555:2017

Nombor	Skema	Imej contoh	Penilaian	Tindakan pembetulan yang disyorkan	Pelengkap kepada
4	**Sambungan satu sisi, titisan kimpalan terjojol** 		**TIDAK BOLEH DITERIMA:** Sambungan kimpalan satu sisi. → **Uji atau tanggalkan** stad yang dikimpal	Patuhi keperluan penyediaan permukaan tersebut dalam Jadual 2. Patuhi keperluan pengapit asas, stad dan jarak tepi.	Jadual A.5, Nombor 4 EN ISO 14555:2017 dan Fasal 9.7.1 AWS D1.6/D1.6M: 2017
5	**Jelaga di sekeliling kimpalan** 		**TIDAK BOLEH DITERIMA:** Stad dengan jelaga di sekeliling kimpalan. → **Uji atau tanggalkan** stad yang dikimpal	Patuhi keperluan penyediaan permukaan tersebut dalam Jadual 2. Pastikan penyediaan permukaan dan stad bebas daripada apa-apa pencemaran.	Jadual A.5, Nombor 3 dan 4 EN ISO 14555:2017
6	**Percikan atau percikan api** 		**TIDAK BOLEH DITERIMA:** Stad dengan percikan atau percikan api di sekeliling kimpalan. → **Uji atau tanggalkan** stad yang dikimpal	Patuhi keperluan penyediaan permukaan tersebut dalam Jadual 2. Pastikan penyediaan permukaan dan stad bebas daripada apa-apa pencemaran.	Jadual A.5, Nombor 3 dan 5 EN ISO 14555:2017 dan Fasal 9.7.1 AWS D1.6/D1.6M: 2017
7	**Diameter kimpalan dikurangkan, sesendal yang luar biasa** 		**TIDAK BOLEH DITERIMA:** Stad dengan diameter yang dikurangkan atau sesendal tinggi yang luar biasa. → **Tanggalkan dan pasang semula** stad	Semak tetapan Kod Kimpalan (Kod-H). Patuhi keperluan penyediaan permukaan dalam Jadual 2. Pastikan penyediaan permukaan dan stad bebas daripada apa-apa pencemaran.	Jadual A.5, Nombor 2 EN ISO 14555:2017 dan Fasal 9.7.1 AWS D1.6/D1.6M: 2017

Nombor	Skema	Imej contoh	Penilaian	Tindakan pembetulan yang disyorkan	Pelengkap kepada
8	**Kod F dipaparkan pada alat** 		**TIDAK BOLEH DITERIMA:** Stad dengan Kod F dipaparkan selepas kimpalan. → **Ikuti tindakan yang diperlukan dalam** Jadual 6	Tindakan pembetulan bergantung pada Kod F yang disenaraikan dalam Jadual 6.	

Jadual 5: Katalog pemeriksaan visual untuk stad F-BT yang dikimpal pada keluli tidak bersalut (permukaan alat FX 3-ST d14)

Nombor	Skema	Imej contoh	Penilaian	Tindakan pembetulan yang disyorkan	Pelengkap kepada
1	**Kolar lengkap biasa di sekeliling pin kimpalan** 		**BOLEH DITERIMA**	Tiada.	Jadual A.5, Nombor 4 EN ISO 14555:2017
2	**Stad sipi** 		**TIDAK BOLEH DITERIMA:** Stad yang dikimpal sipi kepada penyediaan membulat. → **Tanggalkan dan pasang semula** stad	Letakkan hujung stad pada bahagian tengah di pertengahan penyediaan permukaan. Pegang alat tangan FX 3-HT dengan berpusat, serenjang dan tenang.	Jadual A.5, Nombor 4 EN ISO 14555:2017
3	**Stad condong >2°** 		**TIDAK BOLEH DITERIMA:** Stad condong >2°. → **Tanggalkan dan pasang semula** stad	Pegang alat tangan dengan serenjang dan kuat semasa mengimpal. Pastikan bahawa penyediaan permukaan adalah selari dengan permukaan bahan induk.	Jadual A.5, Nombor 4 EN ISO 14555:2017

Nombor	Skema	Imej contoh	Penilaian	Tindakan pembetulan yang disyorkan	Pelengkap kepada
4	**Sambungan satu sisi, titisan kimpalan terjojol** 		**TIDAK BOLEH DITERIMA:** Sambungan kimpalan satu sisi. → **Uji atau tanggalkan** stad yang dikimpal	Patuhi keperluan penyediaan permukaan tersebut dalam Jadual 2. Patuhi keperluan pengapit asas, stad dan jarak tepi.	Jadual A.5, Nombor 4 EN ISO 14555:2017 dan Fasal 9.7.1 AWS D1.6/D1.6M: 2017
5	**Jelaga di sekeliling kimpalan** 		**TIDAK BOLEH DITERIMA:** Stad dengan jelaga di sekeliling kimpalan. → **Uji atau tanggalkan** stad yang dikimpal	Patuhi keperluan penyediaan permukaan tersebut dalam Jadual 3. Pastikan penyediaan permukaan dan stad bebas daripada apa-apa pencemaran.	Jadual A.5, Nombor 3 dan 4 EN ISO 14555:2017
6	**Percikan atau percikan api** 		**TIDAK BOLEH DITERIMA:** Stad dengan percikan atau percikan api di sekeliling kimpalan. → **Uji atau tanggalkan** stad yang dikimpal	Patuhi keperluan penyediaan permukaan tersebut dalam Jadual 3. Pastikan penyediaan permukaan dan stad bebas daripada apa-apa pencemaran.	Jadual A.5, Nombor 3 dan 5 EN ISO 14555:2017 dan Fasal 9.7.1 AWS D1.6/D1.6M: 2017
7	**Diameter kimpalan dikurangkan, sesendal yang luar biasa** 		**TIDAK BOLEH DITERIMA:** Stad dengan diameter yang dikurangkan atau lengkung sesendal tinggi yang luar biasa. → **Tanggalkan dan pasang semula** stad	Semak tetapan Kod Kimpalan. Patuhi keperluan penyediaan permukaan dalam Jadual 3. Pastikan penyediaan permukaan dan stad bebas daripada apa-apa pencemaran.	Jadual A.5, Nombor 2 EN ISO 14555:2017 dan Fasal 9.7.1 AWS D1.6/D1.6M: 2017

Nombor	Skema	Imej contoh	Penilaian	Tindakan pembetulan yang disyorkan	Pelengkap kepada
8	**Kod F dipaparkan pada alat** 		**TIDAK BOLEH DITERIMA:** Stad dengan Kod F dipaparkan selepas kimpalan. → **Ikuti tindakan yang diperlukan dalam** Jadual 6	Tindakan pembetulan bergantung pada Kod F yang disenaraikan dalam Jadual 6.	

Jadual 6: Senarai Kod F, kes kegagalan yang memerlukan penanggalan atau pemeriksaan stad

<table>
<tr><th>Kod F</th><th>Kes kegagalan</th><th>Tindakan yang diperlukan</th></tr>
<tr><td>F06</td><td>Mekanik dalaman alat tangan melekit</td><td rowspan="5">Sama ada:
Uji stad dengan beban bukti tegangan dengan HAT 28 FX. Beban bukti bergantung pada Kod Kimpalan (Kod-H) stad. Jika stad tersebut menahan beban bukti, stad boleh digunakan. Jika tidak, stad tersebut hendaklah dipasang semula.
<table><tr><th>Kod kimpalan (Kod-H)</th><th>Beban bukti tegangan dalam kN (lbf)</th></tr><tr><td>H1</td><td>6 (1350)</td></tr><tr><td>H2</td><td>9 (2025)</td></tr><tr><td>H3</td><td>17 (3820)</td></tr><tr><td>H10</td><td>22 (4950)</td></tr></table>Atau:
Tanggalkan dan pasang semula stad terus tanpa ujian.</td></tr>
<tr><td>F07</td><td>Sambungan elektrik teruk</td></tr>
<tr><td>F10</td><td>Pembenaman stad tidak betul</td></tr>
<tr><td>F14</td><td>Operator mengganggu proses</td></tr>
<tr><td>F16</td><td>Titik tercemar</td></tr>
<tr><td>F17</td><td>Proses dibatalkan</td><td>Tanggalkan dan pasang semula stad</td></tr>
</table>

- Untuk mendapatkan tindakan pembetulan bagi mengelakkan kejadian Kod F berulang, lihat Pelekat dalam kotak Kit.
- Untuk mengetahui pencarisilapan Kod F yang tidak disenaraikan di sini, lihat Pelekat dalam kotak Kit.
- Pengesyoran tentang cara menanggalkan dan memasang semula F-BT boleh didapati dalam prosedur pembaikan untuk F-BT.

REGISTRO ESAME VISIVO HILTI F-BT

L’esame visivo e la valutazione dei prigionieri Hilti F-BT è diviso in due parti.

La prima prevede l'esame della superficie preparata (Tabella 2 e Tabella 3) prima della saldatura e la seconda rappresenta l’esame della saldatura stessa del prigioniero F-BT (Tabella 4 e Tabella 5).

Lo scopo del registro dell’esame è di valutare l’aspetto visivo come accettabile o non accettabile per l’uso.

I criteri per l’aspetto del prigioniero sono complementari ai requisiti delle norme EN ISO 14555:2017 Tabella A.5 e AWS D1.6 Sezione 9.7. Partendo da dette normative, il presente documento affronta le specificità dei prigionieri saldati Hilti F-BT.

Il registro dell’esame della preparazione della superficie è definito esclusivamente per l’aspetto delle preparazioni eseguite utilizzando gli strumenti per la preparazione delle superfici HIlti FX 3-ST.

Il registro dell’esame Hilti F-BT sarà usato ai fini del verbale di qualificazione della procedura di saldatura (WPQR/PQR), nonché per l’esame dei prigionieri durante il controllo del processo, il controllo della saldatura in produzione e il monitoraggio della produzione.

La Tabella 1 spiega come leggere gli schizzi schematici usati in questo catalogo.

Tabella 1: Spiegazione schematica

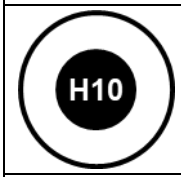
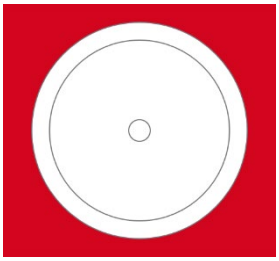
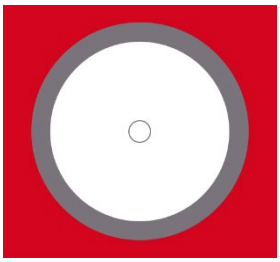
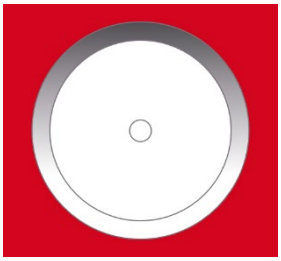
Spiegazione	**schematica**
Esame della preparazione della superficie	
	Vista dall’alto di una preparazione della superficie su acciaio rivestito. Nell’esempio, il colore del rivestimento è il rosso. In entrambe le immagini stilizzate è visibile un anello esterno. L’immagine a sinistra mostra un “anello lucido” sul lato esterno. L’immagine a destra, invece, mostra un anello che presenta residui, con un colore molto più opaco. Il piccolo cerchio al centro delle due immagini rappresenta la rientranza formata dalla punta centrale dello strumento per la preparazione delle superfici.
Esame prigioniero saldato	
	Vista dall’alto di un F-BT saldato al materiale di base preparato con lo strumento per la preparazione delle superfici FX 3-ST d20.
	Vista dall’alto di un F-BT saldato al materiale di base preparato con lo strumento per la preparazione delle superfici FX 3-ST d14.

Tabella 2: Preparazione della superficie di materiale di base rivestito con lo strumento per la preparazione delle superfici FX 3-ST d20

N.	Immagini stilizzate	Immagini di esempio	Valutazione	Azione correttiva raccomandata
1	**Anello vuoto e lucido** 		**ACCETTABILE**	Nessuna
2	**Residui sull'anello esterno** 		**NON ACCETTABILE:** Residui sull'anello esterno.	Continuare il processo di preparazione finché la spalla di arresto (anello esterno) è pulita a 360°. Cambiare strumento di preparazione delle superfici, se necessario.
3	**Superficie della preparazione inclinata** 		**NON ACCETTABILE:** Residui su un lato e preparazioni inclinate.	Continuare il processo di preparazione e inclinare leggermente lo strumento per la preparazione della superficie verso il lato che mostra i residui per rimuoverli e ottenere una superficie piana per l'installazione del prigioniero.
4	**Preparazione irregolare** 		**NON ACCETTABILE:** Residui sulla superficie.	Mantenere e premere lo strumento dritto sulla superficie durante la preparazione. Evitare che lo strumento ondeggi.

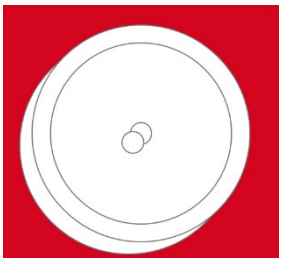
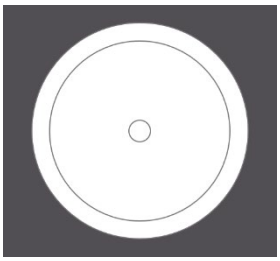
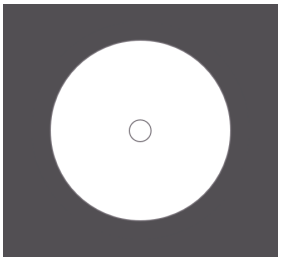
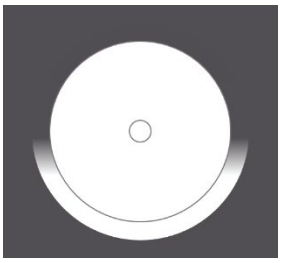
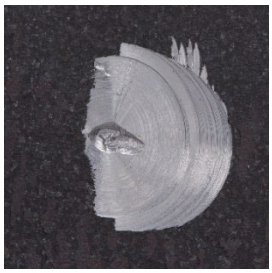
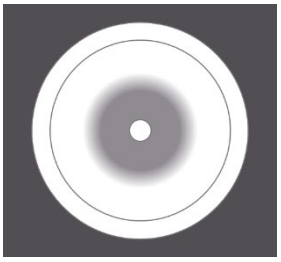
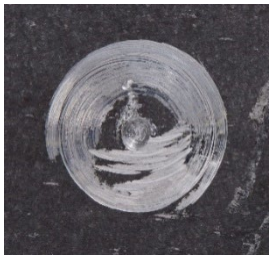
N.	Immagini stilizzate	Immagini di esempio	Valutazione	Azione correttiva raccomandata
5	**Preparazione asimmetrica o sdoppiata** 		**NON ACCETTABILE:** Preparazione asimmetrica che presenta un cerchio sdoppiato.	Non usare preparazioni asimmetriche per la saldatura. Creare una preparazione in una nuova posizione. La volta successiva, mantenere e premere lo strumento dritto e ben saldo durante il processo di preparazione.

Tabella 3: Preparazione della superficie di materiale di base non rivestito con lo strumento per la preparazione delle superfici FX 3-ST d14

N.	Immagini stilizzate	Immagini di esempio	Valutazione	Azione correttiva raccomandata
1	**Anello vuoto e lucido** 		**ACCETTABILE**	Nessuna
2	**Residui sull'anello esterno** 		**NON ACCETTABILE:** Residui sull'anello.	Continuare il processo di preparazione finché la spalla di arresto (anello esterno) è pulita a 360°. Cambiare strumento di preparazione delle superfici, se necessario.
3	**Superficie della preparazione inclinata** 		**NON ACCETTABILE:** Residui su un lato e preparazioni inclinate.	Continuare il processo di preparazione e inclinare leggermente lo strumento per la preparazione della superficie verso il lato che mostra i residui per rimuoverli e ottenere una superficie piana per l'installazione del prigioniero.
4	**Preparazione irregolare** 		**NON ACCETTABILE:** Residui sulla superficie.	Mantenere e premere lo strumento dritto sulla superficie durante la preparazione. Evitare che lo strumento ondeggi.

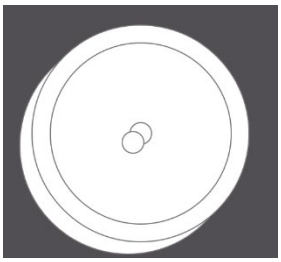
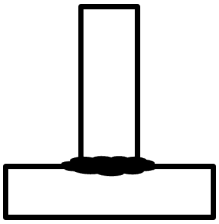
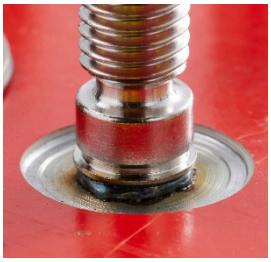
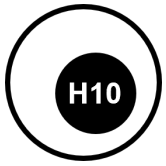
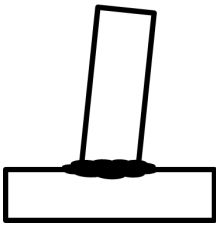
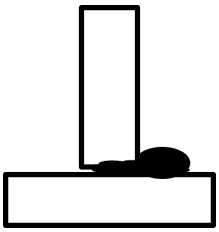
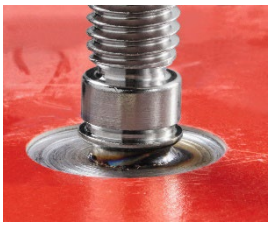
N.	Immagini stilizzate	Immagini di esempio	Valutazione	Azione correttiva raccomandata
5	**Preparazione asimmetrica o sdoppiata** 		**NON ACCETTABILE:** Preparazione asimmetrica o sdoppiata.	Non usare preparazioni asimmetriche per la saldatura. Creare una preparazione in una nuova posizione. La volta successiva, mantenere e premere lo strumento dritto e ben saldo durante il processo di preparazione.

Tabella 4: Registro esame visivo di prigionieri F-BT saldati su acciaio rivestito (strumento per la preparazione delle superfici FX 3-ST d20)

N.	Immagini stilizzate	Immagini di esempio	Valutazione	Azione correttiva raccomandata	Complementare a
1	**Collare regolare e intero** 		**ACCETTABILE**	Nessuna	Tabella A.5, N. 4 di EN ISO 14555:2017
2	**Prigioniero eccentrico** 		**NON ACCETTABILE:** Prigioniero saldato in posizione eccentrica rispetto alla preparazione circolare. → **Rimuovere e reinstallare** il prigioniero	Centrare la punta del prigioniero nel mezzo della superficie preparata. Tenere lo strumento manuale FX 3-HT ben centrato, perpendicolare e fermo.	Tabella A.5, N. 4 di EN ISO 14555:2017
3	**Prigioniero inclinato >2°** 		**NON ACCETTABILE:** Prigioniero inclinato >2°. → **Rimuovere e reinstallare** il prigioniero	Tenere lo strumento manuale perpendicolare e ben saldo durante la saldatura. Accertarsi che la superficie preparata sia parallela alla superficie del materiale di base.	Tabella A.5, N. 4 di EN ISO 14555:2017
4	**Connessione su un solo lato, goccia di saldatura sporgente** 		**NON ACCETTABILE:** Connessione di saldatura su un solo lato. → **Sottoporre a test o rimuovere** il prigioniero saldato	Soddisfare i requisiti per la preparazione della superficie come da Tabella 2. Soddisfare i requisiti per morsetto base, prigioniero e spaziatura dei bordi.	Tabella A.5, N. 4 di EN ISO 14555:2017 e sezione 9.7.1 della AWS D1.6/D1.6M: 2017

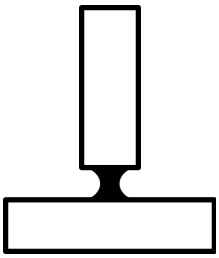
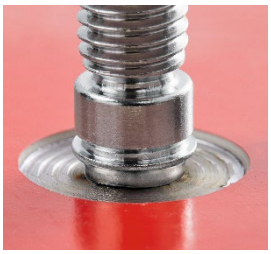
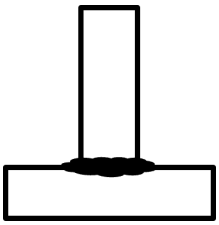
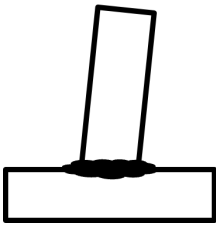
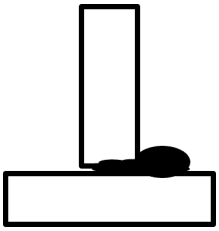
N.	Immagini stilizzate	Immagini di esempio	Valutazione	Azione correttiva raccomandata	Complementare a
5	**Fuliggine intorno alla saldatura** 		**NON ACCETTABILE:** Prigionieri con fuliggine intorno alla saldatura. → **Sottoporre a test o rimuovere** il prigioniero saldato	Soddisfare i requisiti per la preparazione della superficie come da Tabella 2. Accertarsi che la superficie preparate ed il prigioniero siano privi di qualsiasi contaminazione.	Tabella A.5, N. 3 e 4 di EN ISO 14555:2017
6	**Schizzi o perle** 		**NON ACCETTABILE:** Prigionieri con schizzi o residui intorno alla saldatura. → **Sottoporre a test o rimuovere** il prigioniero saldato	Soddisfare i requisiti per la preparazione della superficie come da Tabella 2. Accertarsi che la superficie preparata ed il prigioniero siano privi di qualsiasi contaminazione.	Tabella A.5, N. 3 e 5 di EN ISO 14555:2017 e sezione 9.7.1 della AWS D1.6/D1.6M: 2017
7	**Diametro di saldatura ridotto, distacco inusuale** 		**NON ACCETTABILE:** Prigionieri con diametro ridotto o distacco insolitamente alto. → **Rimuovere e reinstallare** il prigioniero	Controllare la posizione del codice di saldatura (Codice H) Soddisfare i requisiti per la preparazione della superficie come da Tabella 2. Accertarsi che la superficie praparata ed il prigioniero siano privi di qualsiasi contaminazione.	Tabella A.5, N. 2 di EN ISO 14555:2017 e sezione 9.7.1 della AWS D1.6/D1.6M: 2017
8	**Codice F visualizzato sullo strumento** 		**NON ACCETTABILE:** Prigionieri con codice F visualizzato dopo la saldatura. → **Seguire le azioni previste alla** Tabella 6	Azioni correttive in base al codice F elencate nella Tabella 6.	

Tabella 5: Registro esame visivo di prigionieri F-BT saldati su acciaio non rivestito (strumento per la preparazione delle superfici FX 3-ST d14)

N.	Immagini stilizzate	Immagini di esempio	Valutazione	Azione correttiva raccomandata	Complementare a
1	**Collare intero regolare intorno al perno di saldatura** 		**ACCETTABILE**	Nessuna	Tabella A.5, N. 4 di EN ISO 14555:2017
2	**Prigioniero eccentrico** 		**NON ACCETTABILE:** Prigioniero saldato in posizione eccentrica rispetto alla preparazione circolare. → **Rimuovere e reinstallare** il prigioniero	Centrare la punta del prigioniero nel mezzo della superficie preparata. Tenere lo strumento manuale FX 3-HT ben centrato, perpendicolare e fermo.	Tabella A.5, N. 4 di EN ISO 14555:2017
3	**Prigioniero inclinato >2°** 		**NON ACCETTABILE:** Prigioniero inclinato >2°. → **Rimuovere e reinstallare** il prigioniero	Tenere lo strumento manuale perpendicolare e ben saldo durante la saldatura. Accertarsi che la superficie preparata sia parallela alla superficie del materiale di base.	Tabella A.5, N. 4 di EN ISO 14555:2017
4	**Connessione su un solo lato, goccia di saldatura sporgente** 		**NON ACCETTABILE:** Connessione di saldatura su un solo lato. → **Sottoporre a test o rimuovere** il prigioniero saldato	Soddisfare i requisiti per la preparazione della superficie come da Tabella 2. Soddisfare i requisiti per morsetto base, prigioniero e spaziatura dei bordi.	Tabella A.5, N. 4 di EN ISO 14555:2017 e sezione 9.7.1 della AWS D1.6/D1.6M: 2017

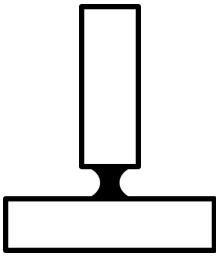
N.	Immagini stilizzate	Immagini di esempio	Valutazione	Azione correttiva raccomandata	Complementare a
5	**Fuliggine intorno alla saldatura** 		**NON ACCETTABILE:** Prigionieri con fuliggine intorno alla saldatura. → **Sottoporre a test o rimuovere** il prigioniero saldato	Soddisfare i requisiti per la preparazione della superficie come da Tabella 3. Accertarsi che la superficie preparata ed il prigioniero siano privi di qualsiasi contaminazione.	Tabella A.5, N. 3 e 4 di EN ISO 14555:2017
6	**Schizzi o perle** 		**NON ACCETTABILE:** Prigionieri con schizzi o residui intorno alla saldatura. → **Sottoporre a test o rimuovere** il prigioniero saldato	Soddisfare i requisiti per la preparazione della superficie come da Tabella 3. Accertarsi che la superficie preparata ed il prigioniero siano privi di qualsiasi contaminazione.	Tabella A.5, N. 3 e 5 di EN ISO 14555:2017 e sezione 9.7.1 della AWS D1.6/D1.6M: 2017
7	**Diametro di saldatura ridotto, distacco inusuale** 		**NON ACCETTABILE:** Prigionieri con diametro ridotto o distacco insolitamente alto. → **Rimuovere e reinstallare** il prigioniero	Controllare la posizione del codice di saldatura Soddisfare i requisiti per la preparazione della superficie come da Tabella 3. Accertarsi che la superficie preparata ed il prigioniero siano privi di qualsiasi contaminazione.	Tabella A.5, N. 2 di EN ISO 14555:2017 e sezione 9.7.1 della AWS D1.6/D1.6M: 2017
8	**Codice F visualizzato sullo strumento** 		**NON ACCETTABILE:** Prigionieri con codice F visualizzato dopo la saldatura. → **Seguire le azioni previste alla** Tabella 6	Azioni correttive in base al codice F elencate nella Tabella 6.	

Tabella 66: Elenco codice F, casi di errore che prevedono la rimozione o l'ispezione del prigioniero

<table>
<tr><th>Codice F</th><th>Caso di errore</th><th>Azione richiesta</th></tr>
<tr><td>F06</td><td>Meccanismo interno allo strumento manuale bloccato</td><td rowspan="5">Opzioni:
Sottoporre il prigioniero a prova di trazione con HAT 28 FX. Il carico di prova a trazione dipende dal codice di saldatura (codice H) del prigioniero. Se il prigioniero resiste al carico di prova può essere utilizzato, altrimenti dovrà essere reinstallato.
<table><tr><th>Codice di saldatura (Codice H)</th><th>Carico di prova a trazione in kN (lbf)</th></tr><tr><td>H1</td><td>6 (1350)</td></tr><tr><td>H2</td><td>9 (2025)</td></tr><tr><td>H3</td><td>17 (3820)</td></tr><tr><td>H10</td><td>22 (4950)</td></tr></table>
oppure:
Rimuovere e reinstallare il prigioniero direttamente, senza alcuna prova.</td></tr>
<tr><td>F07</td><td>Connessione elettrica inadeguata</td></tr>
<tr><td>F10</td><td>Ancoraggio prigioniero non corretto</td></tr>
<tr><td>F14</td><td>Processo interrotto da operatore</td></tr>
<tr><td>F16</td><td>Contaminato da macchie</td></tr>
<tr><td>F17</td><td>Processo interrotto</td><td>Rimuovere e reinstallare il prigioniero</td></tr>
</table>

- Per azioni correttive atte ad evitare il ripresentarsi dei codici F, vedi etichetta all'interno della scatola del kit.
- Per la risoluzione dei problemi di codici F non elencati qui, vedi etichetta all'interno della scatola del kit.
- Consigli su come rimuovere e reinstallare i F-BT sono disponibili nella procedura di riparazione dei F-BT.

HILTI F-BT 육안 검사 카탈로그

Hilti F-BT 스터드의 육안 검사 및 평가 방법은 두 단계로 나뉘어져 있습니다.

첫 번째는 용접 전 표면 처리(표 2 와 표 3) 상태 검사이며, 두 번째는 F-BT 스터드의 용접 그 자체에 대한 것입니다(표 4 와 표 5).

이 검사 카탈로그의 목적은 외형이 사용에 적합한지 여부를 판단하는 것입니다.

스터드 외형의 기준은 EN ISO 14555:2017 표 A.5 와 AWS D1.6 9.7 절의 요구 조건을 준수합니다. 이 문서는 이 표준을 기준으로 하여 Hilti F-BT 용접 스터드의 세부 사항을 다룹니다.

표면 처리에 대한 검사 카탈로그는 Hilti FX 3-S 표면 도구를 사용해 처리된 표면의 외형에 대해서 수립되었습니다.

Hilti F-BT 검사 카탈로그는 용접 절차 인증 기록(WPQR/PQR)뿐만 아니라 공정 제어, 생산 용접 제어 및 생산 감시 과정 도중 스터드 검사에 사용되어야 합니다.

표 1 에 이 카탈로그에 사용된 도식을 읽는 방법에 대한 설명이 제공되어 있습니다.

표 1: 도식 설명

도식	설명
표면 처리 검사	
	코팅된 강철의 처리된 표면의 상면도. 이 예시에서 코팅 색깔은 빨간색입니다. 두 도식 모두에는 외부 링이 표시되어 있습니다. 왼쪽 도식에는 바깥쪽에 “반짝이는 고리” 가 표시되어 있습니다. 한편, 오른쪽 도식에는 잔여물이 있는 고리가 표시되어 있으며, 약간 더 바랜 색입니다. 각 도식의 중앙에 있는 작은 원은 표면 도구의 중앙 팁으로 인해 형성된 홈을 의미합니다.

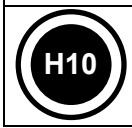
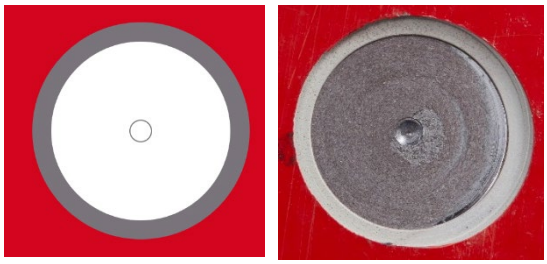
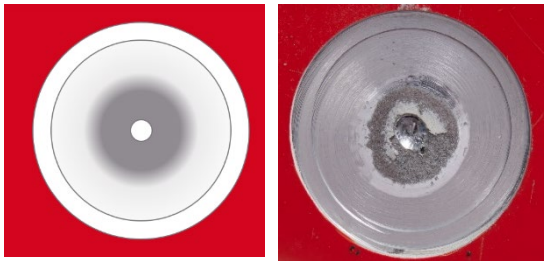
용접된 스터드 검사	
	FX 3-ST d20 표면 도구로 처리된 모재에 용접된 F-BT 의 상면도.
	FX 3-ST d14 표면 도구로 처리된 모재에 용접된 F-BT 의 상면도.

표 2: FX 3-ST d20 표면 도구를 사용한 코팅된 모재의 표면 처리

도식	없음	예시 이미지	평가	권장되는 수정 조치
1	검은색 반짝이는 고리		**양호**	없음
2	외부 고리에 잔여물 존재		**불량:** 외부 고리에 잔여물 존재.	스탑 숄더(외부 고리)가 360° 모두 청결한 상태가 될 때까지 처리 과정을 계속합니다. 필요한 경우 표면 도구를 교체합니다.
3	처리 표면 기울어짐		**불량:** 잔여물이 한쪽에만 존재하며 처리가 기울어져서 이루어짐.	처리 과정을 계속하며 드릴링 기계를 잔여물이 관측된 곳의 방향으로 살짝 기울여 스터드 설치를 위해 고른 표면을 만듭니다.
4	처리 상태 고르지 않음		**불량:** 표면에 잔여물 존재.	표면을 처리할 때 도구를 표면에 대고 누릅니다. 표면 도구가 흔들리는 것을 피합니다.

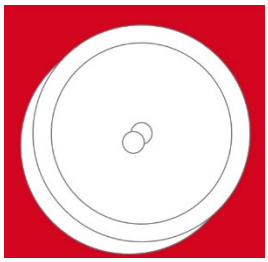
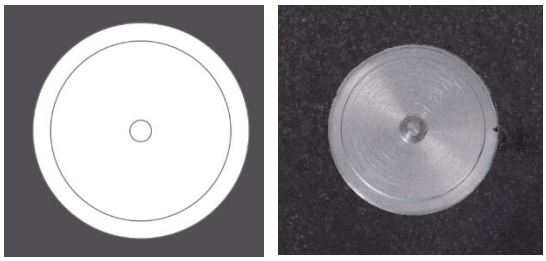
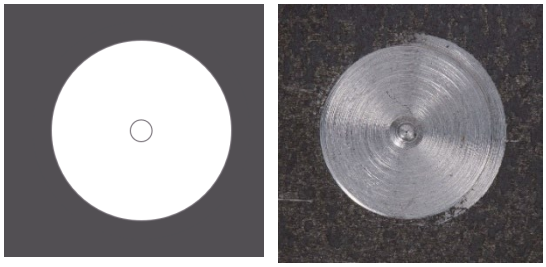
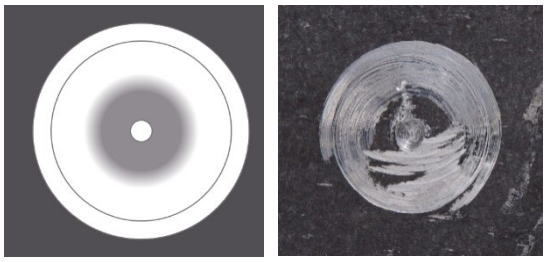
도식	없음	예시 이미지	평가	권장되는 수정 조치
5	비대칭적 혹은 이중 처리	 	**불량:** 비대칭적 처리에 의해 나타난 이중 원.	용접 시 비대칭적 처리를 사용하지 마십시오. 새로운 위치의 표면을 처리합니다. 다음 처리를 할 때 도구를 처리 과정 도중 올바르고 강하게 잡고 누릅니다.

표 3: FX 3-ST d14 표면 도구를 사용한 코팅되지 않은 모재의 표면 처리

도식	없음	예시 이미지	평가	권장되는 수정 조치
1	검은색 반짝이는 고리		**양호**	없음
2	외부 고리에 잔여물 존재		**불량:** 고리에 잔여물 존재.	스탑 숄더(외부 고리)가 360° 모두 청결한 상태가 될 때까지 처리 과정을 계속합니다. 필요한 경우 표면 도구를 교체합니다.
3	처리 표면 기울어짐		**불량:** 잔여물이 한쪽에만 존재하며 처리가 기울어져서 이루어짐.	처리 과정을 계속하며 드릴링 기계를 잔여물이 관측된 곳의 방향으로 살짝 기울여 스터드 설치를 위해 고른 표면을 만듭니다.
4	처리 상태 고르지 않음		**불량:** 표면에 잔여물 존재.	표면을 처리할 때 도구를 표면에 대고 누릅니다. 표면 도구가 흔들리는 것을 피합니다.

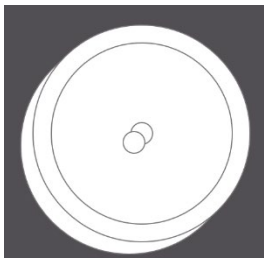
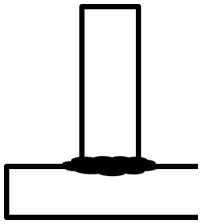
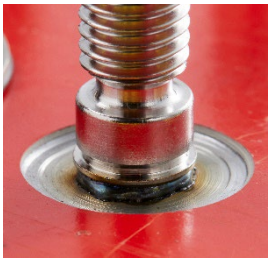
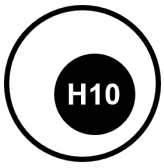
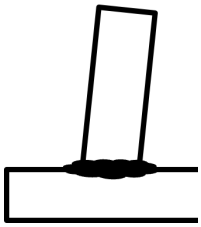
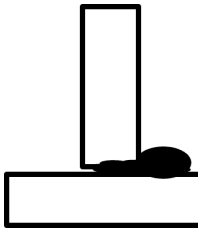
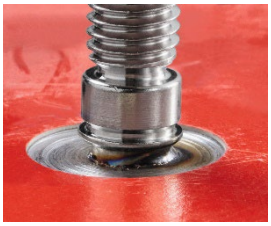
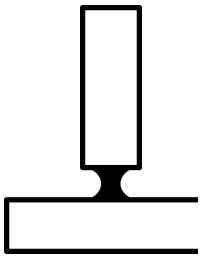
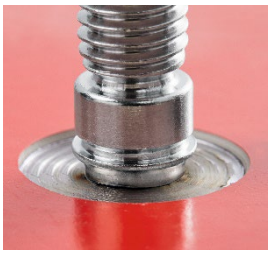
도식	없음	예시 이미지	평가	권장되는 수정 조치
5	**비대칭적 혹은 이중 처리**	 	**불량:** 비대칭적 혹은 이중 처리.	용접 시 비대칭적 처리를 사용하지 마십시오. 새로운 위치의 표면을 처리합니다. 다음 처리를 할 때 도구를 처리 과정 도중 올바르고 강하게 잡고 누릅니다.

표 4: 코팅된 강철에 용접된 F-BT 스터드에 대한 육안 검사 카탈로그 (표면 도구 FX 3-ST d20)

도식	없음	예시 이미지	평가	권장되는 수정 조치	다음과 상호보완적임
1	**규칙적이며 완전한 칼라**	 	**양호**	없음.	EN ISO 14555:2017 의 표 A.5, No. 4
2	**중심이 맞지 않는 스터드**	 	**불량:** 스터드가 원형으로 처리된 표면과 중심이 맞지 않게 용접됨. → 스터드를 **제거 후 재설치합니다**	스터드의 팁을 처리된 표면 중앙에 위치시킵니다. 수동 공구 FX 3-HT 을 중앙에 수직으로 움직이지 않게 잡습니다.	EN ISO 14555:2017 의 표 A.5, No. 4
3	**스터드 경사 >2°**	 	**불량:** 스터드 경사 >2° . → 스터드를 **제거 후 재설치합니다**	용접 시 수동 공구를 수직으로 움직이지 않게 잡습니다. 처리된 표면이 모재 표면과 평행하도록 합니다.	EN ISO 14555:2017 의 표 A.5, No. 4

도식	없음	예시 이미지	평가	권장되는 수정 조치	다음과 상호보완적임
4	**일방적인 연결, 용접 드롭이 표출됨**	 	**불량:** 일방적인 용접 연결. → 용접된 스터드를 **테스트하거나 제거합니다**	표 2 의 표면 처리 요구사항을 따릅니다. 기본 클램프, 스터드 및 가장자리 공간 요구사항을 따릅니다.	EN ISO 14555:2017 의 표 A.5, No. 4 및 AWS D1.6/D1.6M:2017 의 9.7.1 절
5	**용접 주변에 그을음 존재**	 	**불량:** 용접부 주변에 그을음이 존재하는 스터드. → 용접된 스터드를 **테스트하거나 제거합니다**	표 2 의 표면 처리 요구사항을 따릅니다. 처리된 표면과 스터드가 오염되지 않도록 합니다.	EN ISO 14555:2017 의 표 A.5 No. 3 및 4
6	**스플래터 혹은 스파크**	 	**불량:** 용접부 주위에 스플래터 혹은 스파크가 존재하는 스터드. → 용접된 스터드를 **테스트하거나 제거합니다**	표 2 의 표면 처리 요구사항을 따릅니다. 처리된 표면과 스터드가 오염되지 않도록 합니다.	EN ISO 14555:2017 의 표 A.5 No. 3 및 5 및 AWS D1.6/D1.6M:2017 의 9.7.1 절
7	**용접 지름 감소, 비정상적인 용접 간격**	 	**불량:** 지름이 감소하거나 용접 간격이 비정상적으로 높은 스터드 → 스터드를 **제거 후 재설치합니다**	용접 코드(H-코드) 설정을 확인합니다. 표 2 표면 처리 요구사항을 따릅니다. 처리된 표면과 스터드가 오염되지 않도록 합니다.	EN ISO 14555:2017 의 표 A.5, No. 2 및 AWS D1.6/D1.6M:2017 의 9.7.1 절

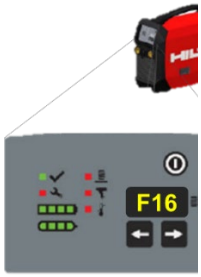
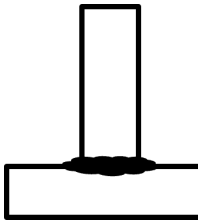
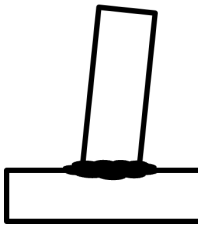
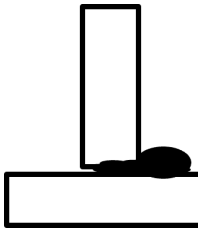
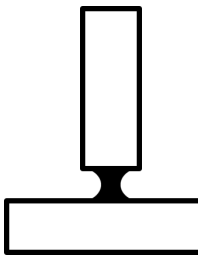
도식	없음	예시 이미지	평가	권장되는 수정 조치	다음과 상호보완적임
8	도구에 F-코드가 표시됨	 	**불량:** 용접 후 F-코드가 표시된 스터드. → 표 6 **에 요구된 조치를 취합니다**	표 6 에 수록된 F-코드에 따른 수정 조치.	

표 5: 코팅되지 않은 강철에 용접된 F-BT 스터드에 대한 육안 검사 카탈로그 (표면 도구 FX 3-ST d14)

도식	없음	예시 이미지	평가	권장되는 수정 조치	다음과 상호보완적임
1	용접 핀 주위에 규칙적인 완전한 칼라	 	**양호**	없음.	EN ISO 14555:2017 의 표 A.5, No. 4
2	중심이 맞지 않는 스터드	 	**불량:** 스터드가 원형으로 처리된 표면과 중심이 맞지 않게 용접됨. → 스터드를 **제거 후 재설치합니다**	스터드의 팁을 처리된 표면 중앙에 위치시킵니다. 수동 공구 FX 3-HT 을 중앙에 수직으로 움직이지 않게 잡습니다.	EN ISO 14555:2017 의 표 A.5, No. 4
3	스터드 경사 >2°	 	**불량:** 스터드 경사 >2° . → 스터드를 **제거 후 재설치합니다**	용접 시 수동 공구를 수직으로 움직이지 않게 잡습니다. 처리된 표면이 모재 표면과 평행하도록 합니다.	EN ISO 14555:2017 의 표 A.5, No. 4

도식	없음	예시 이미지	평가	권장되는 수정 조치	다음과 상호보완적임
4	**일방적인 연결, 용접 드롭이 표출됨** 		**불량:** 일방적인 용접 연결. → 용접된 스터드를 **테스트하거나 제거합니다**	표 2 의 표면 처리 요구사항을 따릅니다. 기본 클램프, 스터드 및 가장자리 공간 요구사항을 따릅니다.	EN ISO 14555:2017 의 표 A.5, No. 4 및 AWS D1.6/D1.6M:2017 의 9.7.1 절
5	**용접 주변에 그을음 존재** 		**불량:** 용접부 주변에 그을음이 존재하는 스터드. → 용접된 스터드를 **테스트하거나 제거합니다**	표 3 의 표면 처리 요구사항을 따릅니다. 처리된 표면과 스터드가 오염되지 않도록 합니다.	EN ISO 14555:2017 의 표 A.5 No. 3 및 4
6	**스플래터 혹은 스파크** 		**불량:** 용접부 주위에 스플래터 혹은 스파크가 존재하는 스터드. → 용접된 스터드를 **테스트하거나 제거합니다**	표 3 의 표면 처리 요구사항을 따릅니다. 처리된 표면과 스터드가 오염되지 않도록 합니다.	EN ISO 14555:2017 의 표 A.5 No. 3 및 5 및 AWS D1.6/D1.6M:2017 의 9.7.1 절
7	**용접 지름 감소, 비정상적인 용접 간격** 		**불량:** 지름이 감소하거나 용접 간격이 비정상적으로 높은 스터드. → 스터드를 **제거 후 재설치합니다**	용접 코드 설정을 확인합니다. 표 3 의 표면 처리 요구사항을 따릅니다. 처리된 표면과 스터드가 오염되지 않도록 합니다.	EN ISO 14555:2017 의 표 A.5, No. 2 및 AWS D1.6/D1.6M:2017 의 9.7.1 절

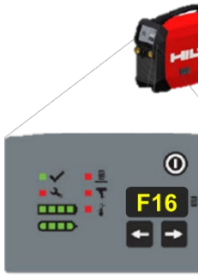
도식	없음	예시 이미지	평가	권장되는 수정 조치	다음과 상호보완적임
8	**도구에 F-코드가 표시됨**	 	**불량:** 용접 후 F-코드가 표시된 스터드. → 표 6 **에 요구된 조치를 취합니다**	표 6 에 수록된 F-코드에 따른 수정 조치.	

표 6: F-코드 목록, 고장 스터드의 제거 혹은 검사가 필요한 사례

<table>
<tr><th>F-코드</th><th>고장 사례</th><th>필요한 조치</th></tr>
<tr><td>F06</td><td>수동 도구의 내부 메커니즘이 끈적임</td><td rowspan="5">다음을 시행합니다.
HAT 28 FX 을 사용해 스터드의 인장보증하중을 테스트합니다.
보증하중은 스터드의 용접 코드(H-코드)에 따라 달라집니다.
스터드가 보증하중을 버틴다면 사용해도 좋으며, 그렇지 않은 경우 재설치해야 합니다.
<table><tr><th>용접 코드(H-코드)</th><th>kN(lbf) 단위의 인장보증하중</th></tr><tr><td>H1</td><td>6(1350)</td></tr><tr><td>H2</td><td>9(2025)</td></tr><tr><td>H3</td><td>17(3820)</td></tr><tr><td>H10</td><td>22(4950)</td></tr></table>
또는, 다음을 시행합니다.
테스트 없이 스터드를 직접 제거 후 재설치합니다.</td></tr>
<tr><td>F07</td><td>전기 연결 불량</td></tr>
<tr><td>F10</td><td>스터드 올바르게 박히지 않음</td></tr>
<tr><td>F14</td><td>작업자가 과정을 중지함</td></tr>
<tr><td>F16</td><td>위치 오염됨</td></tr>
<tr><td>F17</td><td>과정 중단됨</td><td>스터드를 제거 후 재설치합니다</td></tr>
</table>

- F-코드가 반복해서 발생하는 것을 방지하기 위한 수정 조치는 키트 박스 안의 스티커를 참조하십시오.
- 이곳에 명시되지 않은 F-코드의 문제 해결은 키트 박스 안의 스티커를 참조하십시오.
- F-BT 의 권장되는 제거 후 재설치 방법은 F-BT 의 수리 절차에서 확인할 수 있습니다.

LISTA DE COMPROBACIONES VISUALES DE HILTI F-BT

La comprobación visual y la evaluación de los pernos Hilti F-BT se divide en dos partes.

En primer lugar, la comprobación de la preparación de la superficie (tablas 2 y 3) antes de la soldadura y, en segundo lugar, la comprobación de la soldadura de los pernos F-BT (tablas 4 y 5).

El objetivo de la lista de comprobaciones es evaluar el aspecto visual como aceptable o no aceptable para su uso.

Los criterios para el aspecto del perno son complementarios a los requisitos de la norma EN ISO 14555:2017 Tabla A.5 y la Cláusula 9.7 de la AWS D1.6. Tomando como base estas normas, este documento aborda las particularidades de los pernos soldados Hilti F-BT.

La lista de comprobaciones para la preparación de superficies se establece exclusivamente para el aspecto de las preparaciones realizadas con las herramientas de superficie Hilti FX 3-ST.

La lista de comprobaciones de Hilti F-BT se utilizará para el registro de cualificación del procedimiento de soldadura (WPQR/PQR), así como para comprobar los pernos durante el proceso de control, el control de la soldadura de producción y la supervisión de la producción.

En la tabla 1 se explica cómo leer los esquemas utilizados en esta lista.

Tabla 1: Explicación de los esquemas

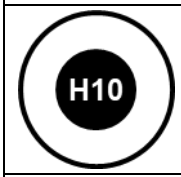
Explicación	**de los esquemas**
Comprobación de la preparación de la superficie	
	Vista desde arriba de una preparación de superficie en acero revestido. En este ejemplo, el color del revestimiento es rojo. En ambos esquemas se muestra un anillo exterior. El esquema de la izquierda muestra un "anillo brillante" en el exterior. Mientras que el esquema de la derecha muestra un anillo con residuos, que tendrá un color más apagado. El pequeño círculo en el centro de cada esquema representa la hendidura formada por la punta central de la herramienta de superficie.
Comprobación de pernos soldados	
	Vista desde arriba de un F-BT soldado al material base preparado con la herramienta de superficie FX 3-ST d20.
	Vista desde arriba de un F-BT soldado al material base preparado con la herramienta de superficie FX 3-ST d14.

Tabla 2: Preparación de la superficie del material de base revestido con la herramienta de superficie FX 3-ST d20

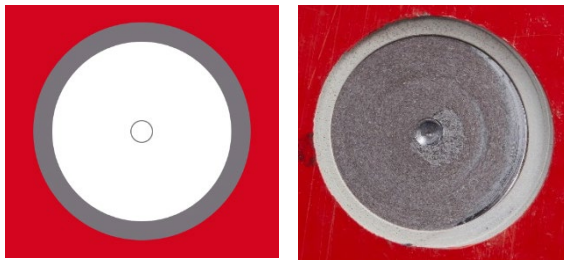
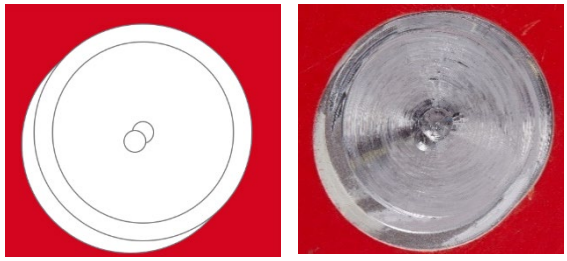
Nº	Esquemas	Imágenes de ejemplo	Evaluación	Acción correctiva recomendada
1	**Anillo en blanco y brillante**		**ACEPTABLE**	Ninguna
2	**Residuos en el anillo exterior**		**NO ACEPTABLE:** Residuos en el anillo exterior.	Continuar el proceso de preparación hasta que el reborde (anillo exterior) esté limpio en los 360° alrededor. Cambiar la herramienta de superficie si es necesario.
3	**Superficie de preparación inclinada**		**NO ACEPTABLE:** Residuos en un lado y preparaciones inclinadas.	Continuar el proceso de preparación e inclinar la perforadora ligeramente hacia un lado, donde se encuentren los residuos para eliminarlos y proporcionar una superficie uniforme para la instalación de los pernos.
4	**Preparación desigual**		**NO ACEPTABLE:** Residuos en la superficie.	Sujetar y presionar la herramienta en línea recta contra la superficie al preparar la superficie. Evitar que la herramienta tiemble.
5	**Preparación asimétrica o doble**		**NO ACEPTABLE:** Una preparación asimétrica que muestra un círculo doble.	No utilizar preparaciones asimétricas para soldar. Crear una preparación en una nueva ubicación. La próxima vez, mantener y presionar la herramienta recta y firme durante el proceso de preparación.

Tabla 3: Preparación de la superficie sin revestimiento con la herramienta de superficie FX 3-ST d14

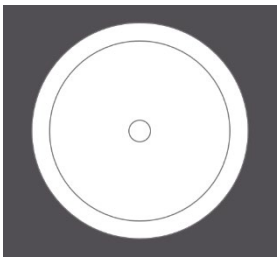
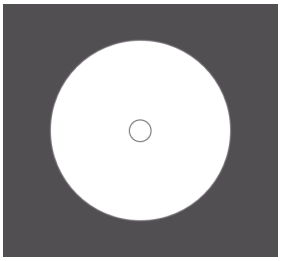
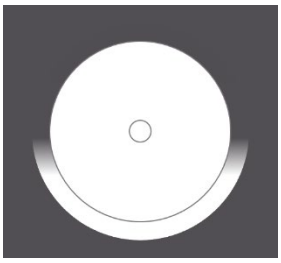
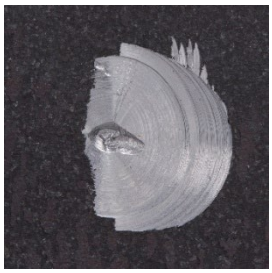
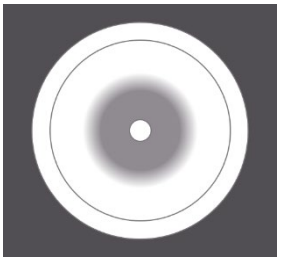
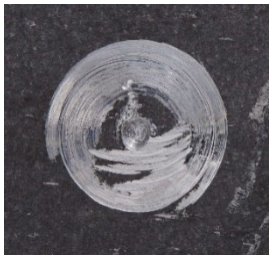
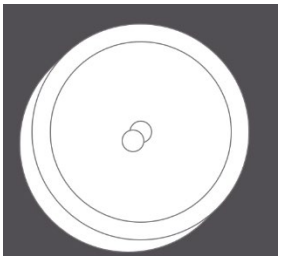
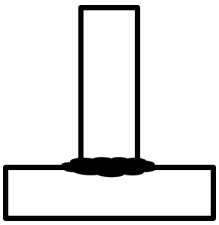
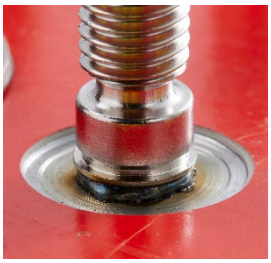
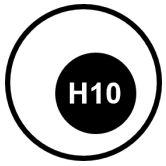
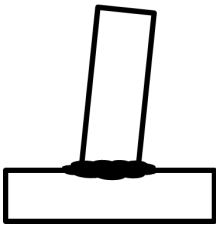
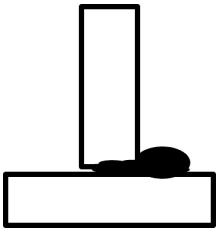
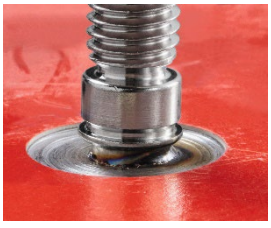
Nº	Esquemas	Imágenes de ejemplo	Evaluación	Acción correctiva recomendada
1	**Anillo en blanco y brillante** 		**ACEPTABLE**	Ninguna
2	**Residuos en el anillo exterior** 		**NO ACEPTABLE:** Residuos en el anillo.	Continuar el proceso de preparación hasta que el reborde (anillo exterior) esté limpio en los 360° alrededor. Cambiar la herramienta de superficie si es necesario.
3	**Superficie de preparación inclinada** 		**NO ACEPTABLE:** Residuos en un lado y preparaciones inclinadas.	Continuar el proceso de preparación e inclinar la perforadora ligeramente hacia un lado, donde se encuentren los residuos para eliminarlos y proporcionar una superficie uniforme para la instalación de los pernos.
4	**Preparación desigual** 		**NO ACEPTABLE:** Residuos en la superficie.	Sujetar y presionar la herramienta en línea recta contra la superficie al preparar la superficie. Evitar que la herramienta tiemble.
5	**Preparación asimétrica o doble** 		**NO ACEPTABLE:** Una preparación asimétrica o doble.	No utilizar preparaciones asimétricas para soldar. Crear una preparación en una nueva ubicación. La próxima vez, mantener y presionar la herramienta recta y firme durante el proceso.

Tabla 4: Lista de comprobaciones visuales de pernos F-BT soldados sobre acero revestido (herramienta de superficie FX 3-ST d20)

Nº	Esquemas	Imágenes de ejemplo	Evaluación	Acción correctiva recomendada	Complementaria
1	**Cuello regular y completo** 		**ACEPTABLE**	Ninguna.	Tabla A.5, nº 4 de EN ISO 14555:2017
2	**Perno excéntrico** 		**NO ACEPTABLE:** Pernos soldados excéntricamente a la preparación circular. → **Quitar y volver a instalar** el perno	Centrar la punta del perno en el centro de la preparación de la superficie. Mantener la herramienta manual FX 3-HT centrada, perpendicular y en calma.	Tabla A.5, nº 4 de EN ISO 14555:2017
3	**Perno inclinado >2°** 		**NO ACEPTABLE:** Pernos inclinados >2° → **Quitar y volver a instalar** el perno	Mantener la herramienta manual perpendicular y firme durante la soldadura. Asegurarse de que la preparación de la superficie es paralela a la superficie del material de base.	Tabla A.5, nº 4 de EN ISO 14555:2017
4	**Conexión desigual por un lado, soldadura con protuberancias** 		**NO ACEPTABLE:** Conexión soldada por un lado. → **Probar o quitar** el perno soldado	Cumplir los requisitos de preparación de la superficie indicados en la Tabla 2. Cumplir los requisitos de espaciado de la base de la herramienta, el perno y el borde.	Tabla A.5, nº 4 de EN ISO 14555:2017 y Cláusula 9.7.1 de la AWS D1.6/D1.6M: 2017

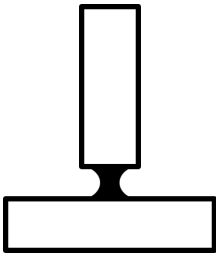
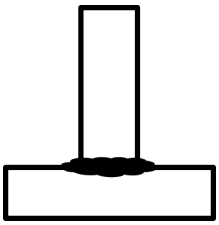
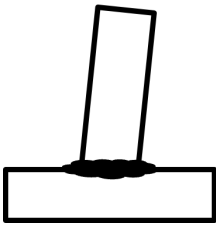
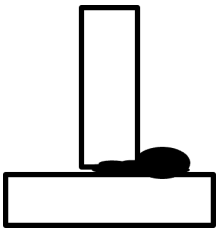
Nº	Esquemas	Imágenes de ejemplo	Evaluación	Acción correctiva recomendada	Complementaria
5	**Hollín alrededor de la soldadura** 		**NO ACEPTABLE:** Pernos con hollín alrededor de la soldadura. → **Probar o quitar** el perno soldado	Cumplir los requisitos de preparación de la superficie indicados en la Tabla 2. Asegurarse de que la preparación de la superficie y el perno están libres de contaminación.	Tabla A.5, Nº 3 y 4 de EN ISO 14555:2017
6	**Salpicaduras o chispas** 		**NO ACEPTABLE:** Pernos con salpicaduras o chispas alrededor de la soldadura. → **Probar o quitar** el perno soldado	Cumplir los requisitos de preparación de la superficie indicados en la Tabla 2. Asegurarse de que la preparación de la superficie y el perno están libres de cualquier contaminación.	Tabla A.5, Nº 3 y 5 de EN ISO 14555:2017 y Cláusula 9.7.1 de la AWS D1.6/D1.6M: 2017
7	**Diámetro de soldadura reducido, fijación a distancia inusual** 		**NO ACEPTABLE:** Pernos con diámetro reducido o fijación a distancia inusualmente alta. → **Quitar y volver a instalar** el perno	Comprobar la configuración de los códigos de soldadura (Código H). Cumplir los requisitos de preparación de la superficie de la Tabla 2. Asegurarse de que la preparación de la superficie y el perno están libres de cualquier contaminación.	Tabla A.5, nº 2 de EN ISO 14555:2017 y Cláusula 9.7.1 de la AWS D1.6/D1.6M: 2017
8	**Se muestra el código F en la herramienta** 		**NO ACEPTABLE:** Pernos con un código F que se muestra después de soldar. → **Seguir las acciones requeridas en la** Tabla 6	Acciones correctivas en función del Código F indicado en la Tabla 6.	

Tabla 5: Lista de comprobaciones visuales de pernos F-BT soldados sobre acero sin revestimiento (herramienta de superficie FX 3-ST d14)

Nº	Esquemas	Imágenes de ejemplo	Evaluación	Acción correctiva recomendada	Complementaria
1	**Cuello regular y completo alrededor del perno de soldadura** 		**ACEPTABLE**	Ninguna.	Tabla A.5, nº 4 de EN ISO 14555:2017
2	**Perno excéntrico** 		**NO ACEPTABLE:** Pernos soldados excéntricamente a la preparación circular. → **Quitar y volver a instalar** el perno	Centrar la punta del perno en el centro de la preparación de la superficie. Mantener la herramienta manual FX 3-HT centrada, perpendicular y en calma.	Tabla A.5, nº 4 de EN ISO 14555:2017
3	**Perno inclinado >2°** 		**NO ACEPTABLE:** Pernos inclinados >2° → **Quitar y volver a instalar** el perno	Mantener la herramienta manual perpendicular y firme durante la soldadura. Asegurarse de que la preparación de la superficie es paralela a la superficie del material de base.	Tabla A.5, nº 4 de EN ISO 14555:2017
4	**Conexión desigual por un lado, soldadura con protuberancias** 		**NO ACEPTABLE:** Conexión soldada por un lado. → **Probar o quitar** el perno soldado	Cumplir los requisitos de preparación de la superficie indicados en la Tabla 2. Cumplir los requisitos de espaciado de la base de la herramienta, el perno y el borde.	Tabla A.5, nº 4 de EN ISO 14555:2017 y Cláusula 9.7.1 de la AWS D1.6/D1.6M: 2017

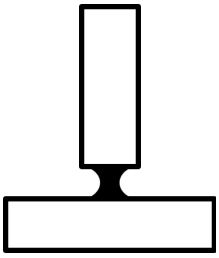
Nº	Esquemas	Imágenes de ejemplo	Evaluación	Acción correctiva recomendada	Complementaria
5	**Hollín alrededor de la soldadura** 		**NO ACEPTABLE:** Pernos con hollín alrededor de la soldadura. → **Probar o quitar** el perno soldado	Cumplir los requisitos de preparación de la superficie indicados en la Tabla 3. Asegurarse de que la preparación de la superficie y el perno están libres de cualquier contaminación.	Tabla A.5, Nº 3 y 4 de EN ISO 14555:2017
6	**Salpicaduras o chispas** 		**NO ACEPTABLE:** Pernos con salpicaduras o chispas alrededor de la soldadura. → **Probar o quitar** el perno soldado	Cumplir los requisitos de preparación de la superficie indicados en la Tabla 3. Asegurarse de que la preparación de la superficie y el perno están libres de cualquier contaminación.	Tabla A.5, Nº 3 y 5 de EN ISO 14555:2017 y Cláusula 9.7.1 de la AWS D1.6/D1.6M: 2017
7	**Diámetro de soldadura reducido, fijación a distancia inusual** 		**NO ACEPTABLE:** Pernos con diámetro reducido o fijación a distancia inusualmente alta. → **Quitar y volver a instalar** el perno	Comprobar la configuración de los códigos de soldadura. Cumplir los requisitos de preparación de la superficie indicados en la Tabla 3. Asegurarse de que la preparación de la superficie y el perno están libres de cualquier contaminación.	Tabla A.5, nº 2 de EN ISO 14555:2017 y Cláusula 9.7.1 de la AWS D1.6/D1.6M: 2017
8	**Se muestra el código F en la herramienta** 		**NO ACEPTABLE:** Pernos con un código F que se muestra después de soldar. → **Seguir las acciones requeridas en la** Tabla 6	Acciones correctivas en función del Código F indicado en la Tabla 6.	

Tabla 6: Lista de códigos F, caso de fallo que requiere quitar o inspeccionar el perno

<table>
<tr><th>Código F</th><th>Caso de fallo</th><th>Acción requerida</th></tr>
<tr><td>F06</td><td>Mecánica interior de la herramienta manual pegajosa</td><td rowspan="4">O bien:
Probar el perno hasta la carga de prueba de tracción con el HAT 28 FX.
La carga de prueba depende del código de soldadura (código H) del perno. Si el perno resiste la carga de prueba, puede utilizarse; de lo contrario debe volver a instalarse.
<table><tr><th>Código de soldadura (Código H)</th><th>Carga de prueba de tracción en kN (lbf)</th></tr><tr><td>H1</td><td>6 (1350)</td></tr><tr><td>H2</td><td>9 (2025)</td></tr><tr><td>H3</td><td>17 (3820)</td></tr><tr><td>H10</td><td>22 (4950)</td></tr></table>O:
Quitar y volver a instalar el perno directamente sin realizar pruebas.</td></tr>
<tr><td>F07</td><td>Conexión eléctrica defectuosa</td></tr>
<tr><td>F10</td><td>Empotramiento incorrecto del perno</td></tr>
<tr><td>F14</td><td>El operario ha interrumpido el proceso</td></tr>
<tr><td>F16</td><td>Punto contaminado</td><td></td></tr>
<tr><td>F17</td><td>Proceso cancelado</td><td>Quitar y volver a instalar el perno</td></tr>
</table>

- Para acciones correctivas para evitar la repetición de los códigos F, consulta la etiqueta adhesiva del interior de la caja.
- Para la resolución de problemas de códigos F no enumerados aquí, consulta la etiqueta adhesiva del interior de la caja.
- Las recomendaciones sobre cómo quitar y volver a instalar pernos F-BT se encuentran en el procedimiento de reparación de F-BT.

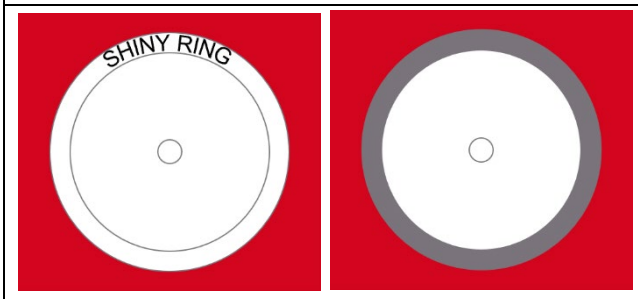
แคตตาล็อกการตรวจสอบ Hilti F-BT ด้วยสายตา

การตรวจสอบและการประเมินสตัด Hilti F-BT ด้วยสายตาแบ่งออกเป็นสองส่วน
ส่วนที่หนึ่งคือการตรวจสอบการเตรียมพื้นผิว (ตารางที่ 2 และตารางที่ 3) ก่อนทำการเชื่อม
และส่วนที่สองคือการตรวจสอบการเชื่อมสตัด F-BT (ตารางที่ 4 และตารางที่ 5)
วัตถุประสงค์ของแคตตาล็อกการตรวจสอบคือเพื่อประเมินลักษณะภายนอกว่ายอมรับในการใช้งานได้หรือไม่
เกณฑ์สำหรับรูปลักษณ์ของสตัดนั้นเป็นข้อมูลเสริมจากข้อกำหนดของ EN ISO 14555:2017 ตาราง A.5 และ AWS D1.6 ข้อ 9.7 เอกสารฉบับนี้ใช้มาตรฐานเหล่านี้เป็นพื้นฐาน และได้กล่าวถึงข้อมูลจำเพาะของสตัด Hilti F-BT ที่ผ่านการเชื่อม

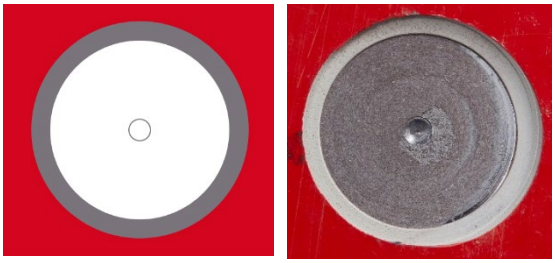
แคตตาล็อกการตรวจสอบเพื่อเตรียมพื้นผิวจัดทำขึ้นเฉพาะสำหรับลักษณะของพื้นที่เตรียมทำงานที่เสร็จสมบูรณ์โดยใช้เครื่องมือเตรียมพื้นผิว Hilti FX 3-ST

ต้องใช้แคตตาล็อกการตรวจสอบ Hilti F-BT สำหรับบันทึกคุณสมบัติของกระบวนการเชื่อม (WPQR/PQR) รวมทั้งการตรวจสอบสตัดระหว่างการควบคุมกระบวนการ การควบคุมการเชื่อมสำหรับการผลิต และการเฝ้าระวังการผลิต
ตารางที่ 1 แสดงคำอธิบายวิธีอ่านร่างแบบแผนที่ใช้ในแคตตาล็อกนี้

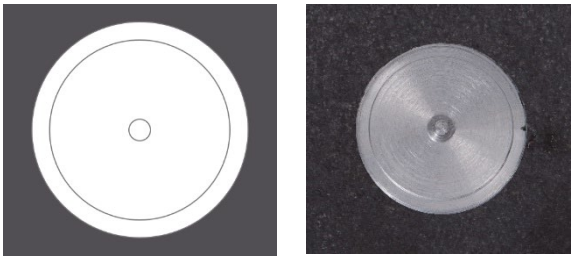
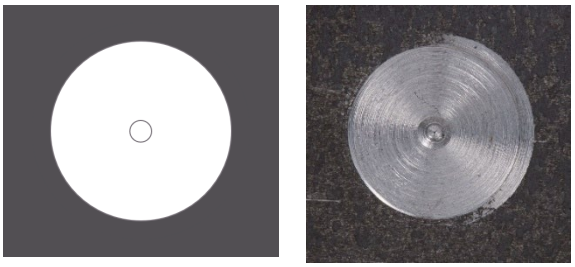
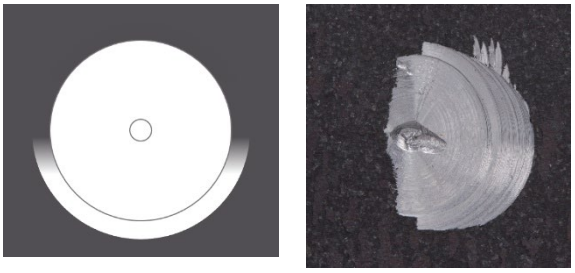
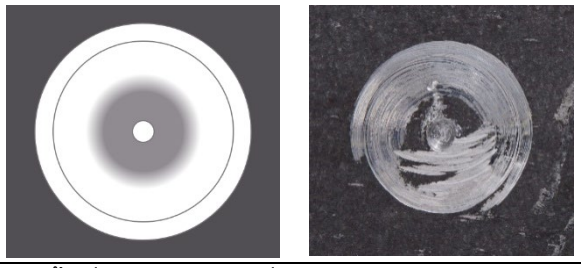
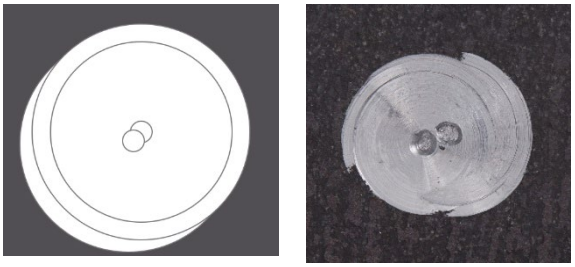
ตาราง 1: คำอธิบายของแบบแผน

คำอธิบาย	แบบแผน
การตรวจสอบการเตรียมพื้นผิว	
	มุมมองจากบนลงล่างของการเตรียมพื้นผิวสำหรับเหล็กเคลือบ สีเคลือบในตัวอย่างนี้เป็นสีแดง แบบแผนทั้งสองแบบนี้แสดงวงแหวนรอบนอก แบบแผนด้านซ้ายแสดง "วงแหวนที่แวววาว" ที่ด้านนอก ในขณะที่แบบแผนด้านขวาแสดงวงแหวนที่มีเศษตกค้างเหลืออยู่ ซึ่งจะเป็นสีที่หม่นกว่า วงกลมขนาดเล็กที่อยู่ตรงกลางของแบบแผนแต่ละแบบแสดงถึงการเยื้องที่เกิดขึ้นจากส่วนปลายตรงกลางของเครื่องมือเตรียมพื้นผิว
การตรวจสอบสตัดที่ผ่านการเชื่อม	
	มุมมองจากบนลงล่างของ F-BT ที่เชื่อมกับวัสดุหลักที่เตรียมด้วยเครื่องมือเตรียมพื้นผิว FX 3-ST d20
	มุมมองจากบนลงล่างของ F-BT ที่เชื่อมกับวัสดุหลักที่เตรียมด้วยเครื่องมือเตรียมพื้นผิว FX 3-ST d14

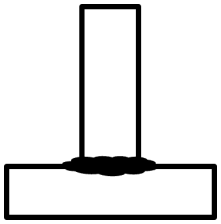
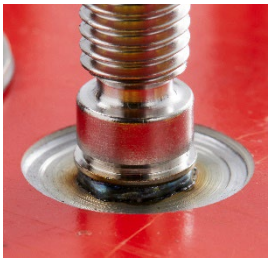
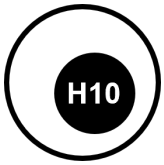
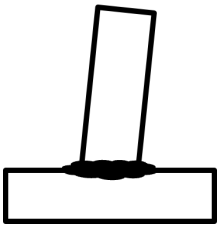
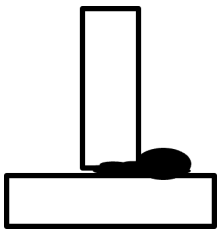
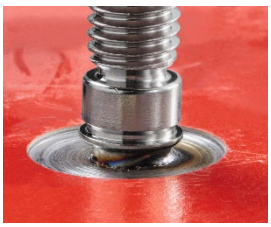
ตาราง 2: การเตรียมพื้นผิวของวัสดุหลักที่เคลือบด้วยเครื่องมือเตรียมพื้นผิว FX 3-ST d20

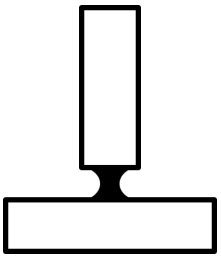
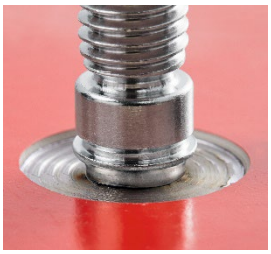
หมายเลข	แบบแผน	ภาพตัวอย่าง	การประเมิน	วิธีแก้ไขที่แนะนำ
1	วงแหวนเปล่าที่แวววาว		**ยอมรับได้**	ไม่มี
2	เศษตกค้างในวงแหวนรอบนอก		**ยอมรับไม่ได้:** เศษตกค้างในวงแหวนรอบนอก	ทำการจัดเตรียมต่อไปจนกว่าขอบ (วงแหวนรอบนอก) จะสะอาดทั่วทั้ง 360° เปลี่ยนเครื่องมือเตรียมพื้นผิวหากจำเป็น
3	พื้นผิวสำหรับเตรียมทำงานเอียง		**ยอมรับไม่ได้:** มีเศษตกค้างด้านหนึ่งและพื้นที่เตรียมทำงานเอียง	จัดเตรียมพื้นที่ทำงานต่อไปค่อยๆ เอียงเครื่องเจาะไปทางด้านที่พบเศษตกค้างอยู่เพื่อนำออก และเตรียมพื้นผิวที่เรียบสำหรับการติดตั้งสตัด
4	พื้นที่เตรียมทำงานไม่เท่ากัน		**ยอมรับไม่ได้:** เศษตกค้างที่พื้นผิว	จับเครื่องมือแล้วกดให้ตรงกับพื้นผิวขณะเตรียมพื้นผิวสำหรับทำงาน หลีกเลี่ยงการโยกเครื่องมือเตรียมพื้นผิว
5	พื้นที่เตรียมทำงานที่ไม่สมมาตรหรือทับซ้อน		**ยอมรับไม่ได้:** พื้นที่เตรียมทำงานที่ไม่สมมาตรจะแสดงวงกลมสองวง	อย่าเชื่อมบนพื้นที่เตรียมทำงานที่ไม่สมมาตร สร้างพื้นที่เตรียมทำงานในพื้นที่ใหม่ ครั้งต่อไปให้จับเครื่องมือแล้วกดให้ตรงและแน่นในระหว่างขั้นตอนการเตรียมพื้นที่ทำงาน

ตาราง 3: การเตรียมพื้นผิวของวัสดุหลักที่ไม่ได้เคลือบด้วยเครื่องมือเตรียมพื้นผิว FX 3-ST d14

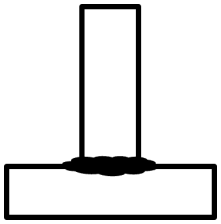
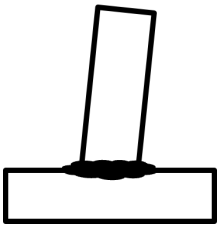
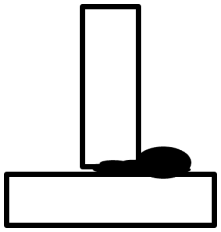
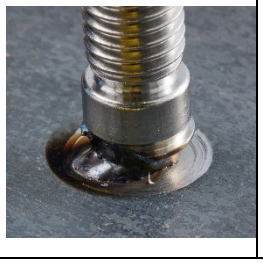
หมายเลข	แบบแผน	ภาพตัวอย่าง	การประเมิน	วิธีแก้ไขที่แนะนำ
1	**วงแหวนเปล่าที่แวววาว**		**ยอมรับได้**	ไม่มี
2	**เศษตกค้างในวงแหวนรอบนอก**		**ยอมรับไม่ได้:** เศษตกค้างในวงแหวน	ทำการจัดเตรียมต่อไปจนกว่าขอบหยุด (วงแหวนรอบนอก) จะสะอาดทั่วทั้ง 360° เปลี่ยนเครื่องมือเตรียมพื้นผิวหากจำเป็น
3	**พื้นผิวสำหรับเตรียมทำงานเอียง**		**ยอมรับไม่ได้:** มีเศษตกค้างด้านหนึ่งและพื้นที่เตรียมทำงานเอียง	จัดเตรียมพื้นที่ทำงานต่อไปค่อยๆ เอียงเครื่องเจาะไปทางด้านที่พบเศษตกค้างอยู่เพื่อนำออก และเตรียมพื้นผิวที่เรียบสำหรับการติดตั้งสตัด
4	**พื้นที่เตรียมทำงานไม่เท่ากัน**		**ยอมรับไม่ได้:** เศษตกค้างที่พื้นผิว	จับเครื่องมือแล้วกดให้ตรงกับพื้นผิวขณะเตรียมพื้นผิวสำหรับทำงาน หลีกเลี่ยงการโยกเครื่องมือเตรียมพื้นผิว
5	**พื้นที่เตรียมทำงานที่ไม่สมมาตรหรือทับซ้อน**		**ยอมรับไม่ได้:** พื้นที่เตรียมทำงานที่ไม่สมมาตรหรือทับซ้อน	อย่าเชื่อมบนพื้นที่เตรียมทำงานที่ไม่สมมาตร สร้างพื้นที่เตรียมทำงานในพื้นที่ใหม่ ครั้งต่อไปให้จับเครื่องมือแล้วกดให้ตรงและแน่นในระหว่างขั้นตอนการเตรียมพื้นที่ทำงาน

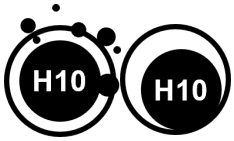
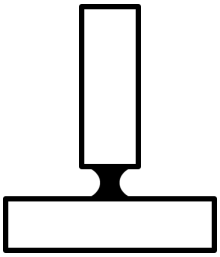
ตาราง 4: แคตตาล็อกการตรวจสอบสตัด F-BT ที่เชื่อมบนเหล็กเคลือบด้วยสายตา (เครื่องมือเตรียมพื้นผิว FX 3-ST d20)

หมายเลข	แบบแผน	ภาพตัวอย่าง	การประเมิน	วิธีแก้ไขที่แนะนำ	ข้อมูลเสริมสำหรับ
1	**รอยเชื่อมที่ปกติและสมบูรณ์** 		**ยอมรับได้**	ไม่มี	ตาราง A.5, หมายเลข 4 ของ EN ISO 14555:2017
2	**สตัดที่ผิดปกติ** 		**ยอมรับไม่ได้:** สตัดที่เชื่อมอย่างผิดปกติสำหรับพื้นที่เตรียมทำงานแบบวงกลม → **ถอดสตัดและติดตั้งใหม่**	วางปลายสตัดไว้ตรงกลางของพื้นที่เตรียมทำงาน จับเครื่องมือ FX 3-HT ให้อยู่ตรงกลางตั้งฉาก และห้ามขยับ	ตาราง A.5, หมายเลข 4 ของ EN ISO 14555:2017
3	**สตัดที่เอียง >2°** 		**ยอมรับไม่ได้:** สตัดที่เอียง >2° → **ถอดสตัดและติดตั้งใหม่**	จับเครื่องมือให้ตั้งฉากและมั่นคงขณะทำการเชื่อม ตรวจสอบให้แน่ใจว่าการเตรียมพื้นผิวขนานกับพื้นผิววัสดุหลัก	ตาราง A.5, หมายเลข 4 ของ EN ISO 14555:2017
4	**การเชื่อมต่อด้านเดียว รอยเชื่อมที่เกยออกมา** 		**ยอมรับไม่ได้:** การเชื่อมเข้ากันด้านเดียว → **ทดสอบหรือนำสตัดที่เชื่อมออก**	ปฏิบัติตามข้อกำหนดการเตรียมพื้นผิวใน ตาราง 2 ปฏิบัติตามข้อกำหนดด้านแคลมป์ฐานสตัดและระยะห่างขอบ	ตาราง A.5, หมายเลข 4 ของ EN ISO 14555:2017 และข้อ 9.7.1 ของ AWS D1.6/D1.6M: 2017

หมายเลข	แบบแผน	ภาพตัวอย่าง	การประเมิน	วิธีแก้ไขที่แนะนำ	ข้อมูลเสริมสำหรับ
5	**เขม่าดำรอบจุดเชื่อม** 		**ยอมรับไม่ได้:** สตัดที่มีเขม่าดำรอบจุดเชื่อม → **ทดสอบหรือนำสตัดที่เชื่อมออก**	ปฏิบัติตามข้อกำหนดของการเตรียมพื้นผิวใน ตาราง 2. ตรวจสอบให้แน่ใจว่าการเตรียมพื้นผิวและสตัดไม่มีสิ่งปนเปื้อนใดๆ	ตาราง A.5, หมายเลข 3 และ 4 ของ EN ISO 14555:2017
6	**สะเก็ดเชื่อมหรือประกายไฟ** 		**ยอมรับไม่ได้:** สตัดที่มีสะเก็ดเชื่อมหรือประกายไฟรอบจุดเชื่อม → **ทดสอบหรือนำสตัดที่เชื่อมออก**	ปฏิบัติตามข้อกำหนดของการเตรียมพื้นผิวใน ตาราง 2. ตรวจสอบให้แน่ใจว่าการเตรียมพื้นผิวและสตัดไม่มีสิ่งปนเปื้อนใดๆ	ตาราง A.5, หมายเลข 3 และ 5 ของ EN ISO 14555:2017 และข้อ 9.7.1 ของ AWS D1.6/D1.6M: 2017
7	**เส้นผ่านศูนย์กลางรอยเชื่อมลดลง การแยกห่างผิดปกติ** 		**ยอมรับไม่ได้:** สตัดที่มีเส้นผ่านศูนย์กลางลดลงหรือแยกห่างผิดปกติ → **ถอดสตัดและติดตั้งใหม่**	ตรวจสอบการตั้งรหัสการเชื่อม (รหัส-H) ปฏิบัติตามข้อกำหนดของการเตรียมพื้นผิวใน ตาราง 2. ตรวจสอบให้แน่ใจว่าการเตรียมพื้นผิวและสตัดไม่มีสิ่งปนเปื้อนใดๆ	ตาราง A.5, หมายเลข 2 ของ EN ISO 14555:2017 และ ข้อ 9.7.1 ของ AWS D1.6/D1.6M: 2017
8	**รหัส-F แสดงที่เครื่องมือ** 		**ยอมรับไม่ได้:** สตัดที่มีรหัส-F แสดงหลังจากที่เชื่อม → **ปฏิบัติตามข้อกำหนดในตาราง 6**	วิธีแก้ไขขึ้นอยู่กับรหัส-F ที่ระบุไว้ในตาราง 6	

ตาราง 5: แคตตาล็อกการตรวจสอบสตัด F-BT ที่เชื่อมบนเหล็กที่ไม่ได้เคลือบด้วยสายตา (เครื่องมือเตรียมพื้นผิว FX 3-ST d14)

หมายเลข	แบบแผน	ภาพตัวอย่าง	การประเมิน	วิธีแก้ไขที่แนะนำ	ข้อมูลเสริมสำหรับ
1	**รอยเชื่อมที่สมบูรณ์และปกติรอบหมุดเชื่อม** 		**ยอมรับได้**	ไม่มี	ตาราง A.5, หมายเลข 4 ของ EN ISO 14555:2017
2	**สตัดที่ผิดปกติ** 		**ยอมรับไม่ได้:** สตัดที่เชื่อมอย่างผิดปกติสำหรับพื้นที่เตรียมทำงานแบบวงกลม → **ถอดสตัดและติดตั้งใหม่**	วางปลายสตัดไว้ตรงกลางของพื้นที่เตรียมทำงาน จับเครื่องมือช่าง FX 3-HT ให้อยู่ตรงกลางตั้งฉากโดยไม่ขยับ	ตาราง A.5, หมายเลข 4 ของ EN ISO 14555:2017
3	**สตัดที่เอียง >2°** 		**ยอมรับไม่ได้:** สตัดที่เอียง >2° → **ถอดสตัดและติดตั้งใหม่**	จับเครื่องมือช่างให้ตั้งฉากและมั่นคงขณะทำการเชื่อม ตรวจสอบให้แน่ใจว่าการเตรียมพื้นผิวขนานกับพื้นผิววัสดุหลัก	ตาราง A.5, หมายเลข 4 ของ EN ISO 14555:2017
4	**การเชื่อมต่อด้านเดียว รอยเชื่อมที่เกยออกมา** 		**ยอมรับไม่ได้:** การเชื่อมเข้ากันด้านเดียว → **ทดสอบหรือนำสตัดที่เชื่อมออก**	ปฏิบัติตามข้อกำหนดการเตรียมพื้นผิวใน ตาราง 2 ปฏิบัติตามข้อกำหนดด้านแคลมป์ฐาน สตัด และระยะห่างขอบ	ตาราง A.5, หมายเลข 4 ของ EN ISO 14555:2017 และ ข้อ 9.7.1 ของ AWS D1.6/D1.6M: 2017

หมายเลข	แบบแผน	ภาพตัวอย่าง	การประเมิน	วิธีแก้ไขที่แนะนำ	ข้อมูลเสริมสำหรับ
5	**เขม่าดำรอบจุดเชื่อม** 		**ยอมรับไม่ได้:** สตัดที่มีเขม่าดำรอบจุดเชื่อม → **ทดสอบหรือนำสตัดที่เชื่อมออก**	ปฏิบัติตามข้อกำหนดการเตรียมพื้นผิวในตารางที่ 3 ตรวจสอบให้แน่ใจว่าการเตรียมพื้นผิวและสตัดไม่มีสิ่งปนเปื้อนใดๆ	ตาราง A.5, หมายเลข 3 และ 4 ของ EN ISO 14555:2017
6	**สะเก็ดเชื่อมหรือประกายไฟ** 		**ยอมรับไม่ได้:** สตัดที่มีสะเก็ดเชื่อมหรือประกายไฟรอบจุดเชื่อม → **ทดสอบหรือนำสตัดที่เชื่อมออก**	ปฏิบัติตามข้อกำหนดการเตรียมพื้นผิวในตารางที่ 3 ตรวจสอบให้แน่ใจว่าการเตรียมพื้นผิวและสตัดไม่มีสิ่งปนเปื้อนใดๆ	ตาราง A.5, หมายเลข 3 และ 5 ของ EN ISO 14555:2017 และ ข้อ 9.7.1 ของ AWS D1.6/D1.6M: 2017
7	**เส้นผ่านศูนย์กลางรอยเชื่อมลดลงการแยกห่างผิดปกติ** 		**ยอมรับไม่ได้:** สตัดที่มีเส้นผ่านศูนย์กลางลดลงหรือแยกห่างอย่างผิดปกติ → **ถอดสตัดและติดตั้งใหม่**	ตรวจสอบการตั้งรหัสการเชื่อม ปฏิบัติตามข้อกำหนดการเตรียมพื้นผิวในตารางที่ 3 ตรวจสอบให้แน่ใจว่าการเตรียมพื้นผิวและสตัดไม่มีสิ่งปนเปื้อนใดๆ	ตาราง A.5, หมายเลข 2 ของ EN ISO 14555:2017 และ ข้อ 9.7.1 ของ AWS D1.6/D1.6M: 2017
8	**รหัส-F แสดงที่เครื่องมือ** 		**ยอมรับไม่ได้:** สตัดที่มีรหัส-F แสดงหลังจากที่เชื่อม → **ปฏิบัติตามข้อกำหนดในตาราง** 6	วิธีแก้ไขขึ้นอยู่กับรหัส-F ที่ระบุไว้ในตาราง 6	

ตาราง 6: รายการรหัส-F กรณีขัดข้องที่ต้องถอดหรือตรวจสอบสตัด

<table>
<tr><th>รหัส-F</th><th>กรณีขัดข้อง</th><th>การดำเนินการที่ต้องทำ</th></tr>
<tr><td>F06</td><td>กลไกภายในของเครื่องมือติดขัด</td><td rowspan="5">หรือ:
ทดสอบสตัดเพื่อตรวจสอบแรงดึงสำหรับตรวจสอบได้ด้วย HAT 28 FX
แรงดึงสำหรับตรวจสอบขึ้นอยู่กับรหัสเชื่อม (รหัส-H) ของสตัด
หากสตัดทนทานต่อแรงดึงสำหรับตรวจสอบ
แสดงว่าสามารถใช้งานได้ดี มิฉะนั้นจะต้องติดตั้งใหม่
<table><tr><th>รหัสเชื่อม (รหัส-H)</th><th>แรงดึงสำหรับตรวจสอบหน่วย kN (lbf)</th></tr><tr><td>H1</td><td>6 (1350)</td></tr><tr><td>H2</td><td>9 (2025)</td></tr><tr><td>H3</td><td>17 (3820)</td></tr><tr><td>H10</td><td>22 (4950)</td></tr></table>หรือ:
นำสตัดออกและติดตั้งใหม่โดยตรง โดยไม่ต้องทดสอบ</td></tr>
<tr><td>F07</td><td>การเชื่อมต่อระบบไฟฟ้าไม่ดี</td></tr>
<tr><td>F10</td><td>การติดตั้งสตัดไม่เหมาะสม</td></tr>
<tr><td>F14</td><td>การติดตั้งถูกขัดจังหวะ</td></tr>
<tr><td>F16</td><td>มีจุดปนเปื้อน</td></tr>
<tr><td>F17</td><td>กระบวนการทำงานถูกยกเลิก</td><td>ถอดสตัดและติดตั้งใหม่</td></tr>
</table>

- สำหรับวิธีการแก้ไขเพื่อหลีกเลี่ยงการเกิด รหัส-F ซ้ำๆ โปรดดูสติกเกอร์ด้านในกล่องเครื่องมือ
- สำหรับการแก้ไขปัญหา รหัส-F ที่ไม่ได้ระบุไว้ที่นี่ โปรดดูสติกเกอร์ด้านในกล่องเครื่องมือ
- คำแนะนำเกี่ยวกับวิธีถอดและติดตั้ง F-BT ใหม่สามารถดูได้จากขั้นตอนการซ่อม F-BT

HILTI F-BT GÖRSEL İNCELEME KATALOĞU

Hilti F-BT saplamalar için görsel inceleme ve değerlendirme iki bölüme ayrılmıştır.

Birincisi kaynaklamadan önce yüzey hazırlığının incelenmesi (Tablo 2 ve Tablo 3) ve ikincisi F-BT saplama kaynağının kendisinin incelenmesidir (Tablo 4 ve Tablo 5).

İnceleme kataloğunun amacı, görünümün kullanım için kabul edilebilir ya da kabul edilemez olduğunu değerlendirmektir.

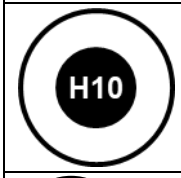
Saplamanın görünümüne ilişkin kriterler EN ISO 14555:2017 Tablo A.5 ve AWS D1.6 Madde 9.7'nin gerekliliklerini tamamlayıcı niteliktedir. Bu standartları temel alan bu belge, Hilti F-BT kaynaklı saplamaların özelliklerini ele almaktadır.

Yüzey hazırlığı için inceleme kataloğu, sadece Hilti FX 3-ST yüzey aletleri kullanılarak yapılan hazırlıkların görünümü için oluşturulmuştur.

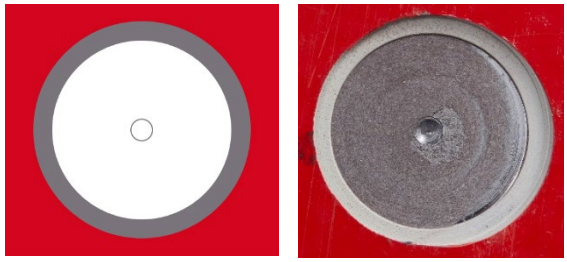
Hilti F-BT inceleme kataloğu, kaynak prosedürü yeterlilik kaydının (WPQR/PQR) yanı sıra proses kontrolü, üretim kaynak kontrolü ve üretim gözetimi sırasında saplama incelemesi için kullanılmalıdır.

Tablo 1'de bu katalogda kullanılan şema çizimlerin nasıl okunacağı açıklanmaktadır.

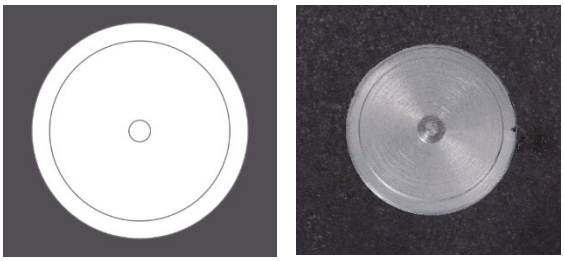
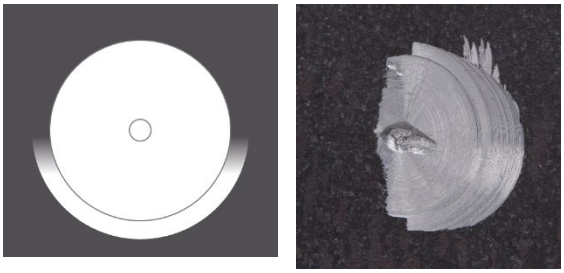
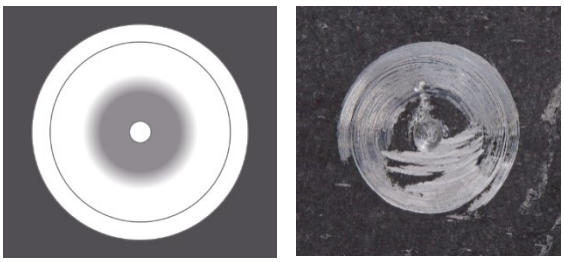
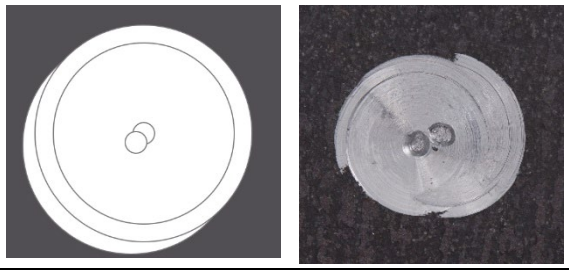
Tablo 1: Şema açıklaması

Şema	Açıklama
Yüzey hazırlığı incelemesi	
 shiny ring = parlak halka	Kaplanmış çelik üzerindeki bir yüzey hazırlığının yukarıdan aşağıya görünümü. Bu örnekte kaplama rengi kırmızıdır. Her iki şemada bir dış halka gösterilmektedir. Sol şemada, dış kısımda bir "parlak halka" gösterilmektedir. Sağdaki şemada ise daha donuk bir renkte olacak, kalıntılara sahip bir halka gösterilmektedir. Her bir şemanın ortasındaki küçük daire, yüzey aracının orta ucu tarafından oluşturulan girintiyi temsil eder.
Kaynaklı saplama incelemesi	
	FX 3-ST d20 yüzey aleti ile hazırlanmış ana malzemeye kaynaklanmış bir F-BT'nin yukarıdan aşağıya görünümü.
	FX 3-ST d14 yüzey aleti ile hazırlanmış ana malzemeye kaynaklanmış bir F-BT'nin yukarıdan aşağıya görünümü.

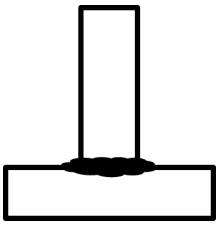
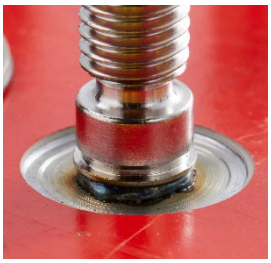
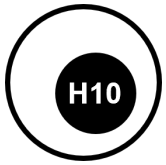
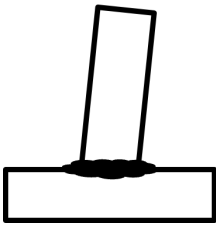
Tablo 2: Kaplanmış ana malzemenin yüzey aleti FX 3-ST d20 ile yapılmış yüzey hazırlığı

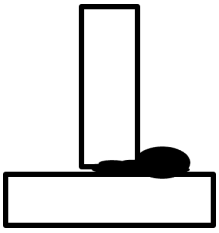
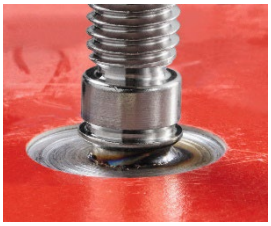
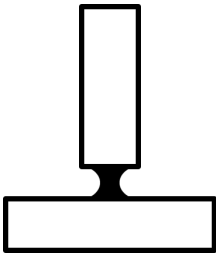
No	Şema	Örnek görüntüler	Değerlendirme	Önerilen düzeltme işlemi
1	**Boş ve parlak halka**		**KABUL EDİLEBİLİR**	Yok
2	**Dış halkada kalıntılar**		**KABUL EDİLEMEZ:** Dış halkada kalıntılar.	Dış halka 360° temiz olana kadar hazırlık işlemine devam edin. Gerekiyorsa yüzey aletini değiştirin.
3	**Eğimli hazırlık yüzeyi**		**KABUL EDİLEMEZ:** Tek taraflı kalıntılar ve eğimli hazırlıklar.	Hazırlık işlemine devam edin ve delme makinesini kalıntıların bulunduğu tarafa doğru hafifçe eğerek kalıntıları giderin ve saplama montajı için düz bir yüzey sağlayın.
4	**Eşit olmayan hazırlık**		**KABUL EDİLEMEZ:** Yüzeyde kalıntılar.	Yüzeyi hazırlarken aleti düz tutun ve yüzeye bastırın. Yüzey aletinin sallanmasını önleyin.
5	**Simetrik olmayan ya da çift hazırlık**		**KABUL EDİLEMEZ:** İki halkanın göründüğü simetrik olmayan hazırlık.	Kaynaklama için simetrik olmayan hazırlıkları kullanmayın. Yeni bir konumda bir hazırlık oluşturun. Bir sonraki sefer hazırlık işlemi sırasında aleti düz ve sıkı tutun ve bastırın.

Tablo 3: Kaplanmamış ana malzemenin yüzey aleti FX 3-ST d14 ile yapılmış yüzey hazırlığı

No	Şema	Örnek görüntüler	Değerlendirme	Önerilen düzeltme işlemi
1	**Boş ve parlak halka**		**KABUL EDİLEBİLİR**	Yok
2	**Dış halkada kalıntılar**		**KABUL EDİLEMEZ:** Halkada kalıntılar.	Dış halka 360° temiz olana kadar hazırlık işlemine devam edin. Gerekiyorsa yüzey aletini değiştirin.
3	**Eğimli hazırlık yüzeyi**		**KABUL EDİLEMEZ:** Tek taraflı kalıntılar ve eğimli hazırlıklar.	Hazırlık işlemine devam edin ve delme makinesini kalıntıların bulunduğu tarafa doğru hafifçe eğerek kalıntıları giderin ve saplama montajı için düz bir yüzey sağlayın.
4	**Eşit olmayan hazırlık**		**KABUL EDİLEMEZ:** Yüzeyde kalıntılar.	Yüzeyi hazırlarken aleti düz tutun ve yüzeye bastırın. Yüzey aletinin sallanmasını önleyin.
5	**Simetrik olmayan ya da çift hazırlık**		**KABUL EDİLEMEZ:** Simetrik olmayan ya da çift hazırlık.	Kaynaklama için simetrik olmayan hazırlıkları kullanmayın. Yeni bir konumda bir hazırlık oluşturun. Bir sonraki sefer hazırlık işlemi sırasında aleti düz ve sıkı tutun ve bastırın.

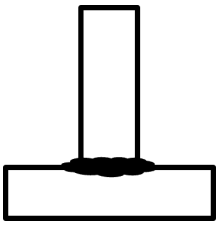
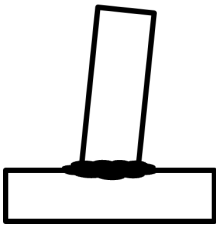
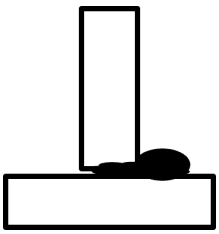
Tablo 4: Kaplamalı çelik üzerine kaynaklanan F-BT saplamaları için görsel inceleme kataloğu (yüzey aleti FX 3-ST d20)

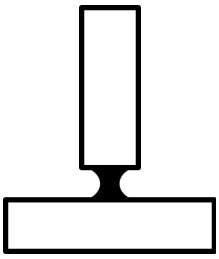
No	Şema	Örnek görüntüler	Değerlendirme	Önerilen düzeltme işlemi	Bunu tamamlar
1	**Düzgün ve tam halka** 		**KABUL EDİLEBİLİR**	Yok.	EN ISO 14555:2017, Tablo A.5, No. 4
2	**Merkezi olmayan saplama** 		**KABUL EDİLEMEZ:** Yuvarlak hazırlığa merkezi olmayan şekilde kaynaklanmış saplamalar. →Saplamayı **çıkarın ve yeni bir saplama kullanın.**	Saplamanın ucunu, hazırlanmış yüzeyin ortasına merkezleyin. FX 3-HT el aletini merkezli, dik ve sakin tutun.	EN ISO 14555:2017, Tablo A.5, No. 4
3	**>2° eğimli saplama** 		**KABUL EDİLEMEZ:** >2° eğimli saplamalar. →Saplamayı **çıkarın ve yeni bir saplama kullanın.**	Kaynaklama sırasında el aletini dik ve sıkı tutun. Yüzey hazırlığının ana malzeme yüzeyine paralel olduğundan emin olun.	EN ISO 14555:2017, Tablo A.5, No. 4

No	Şema	Örnek görüntüler	Değerlendirme	Önerilen düzeltme işlemi	Bunu tamamlar
4	**Tek taraflı bağlantı, kaynak damlası dışarı çıkmış** 		**KABUL EDİLEMEZ:** Tek taraflı kaynak bağlantısı. → Kaynaklanan saplamayı **çıkarın ve yeni bir saplama kullanın.**	Tablo 2'de verilen yüzey hazırlık gerekliliklerine uyun. Taban bağlaması, saplama ve kenar boşluğu gerekliliklerine uyun.	EN ISO 14555:2017, Tablo A.5, No. 4 ve AWS D1.6/D1.6M: 2017, Madde 9.7.1
5	**Kaynağın etrafında is var** 		**KABUL EDİLEMEZ:** Kaynağın etrafında is olan saplamalar. → Kaynaklanan saplamayı **çıkarın ve yeni bir saplama kullanın**	Burada verilen yüzey hazırlık gerekliliklerine uyun: Tablo 2. Yüzey hazırlığı ve saplamada herhangi bir kirlenme olmadığından emin olun.	Tablo A.5, No. 3 ve 4, EN ISO 14555:2017
6	**Sıçramalar veya kaynak parçaları** 		**KABUL EDİLEMEZ:** Kaynağın etrafında sıçrama ya da kaynak parçaları olan saplamalar. → Kaynaklanan saplamayı **çıkarın ve yeni bir saplama kullanın.**	Burada verilen yüzey hazırlık gerekliliklerine uyun: Tablo 2. Yüzey hazırlığı ve saplamada herhangi bir kirlenme olmadığından emin olun.	Tablo A.5, No. 3 ve 5, EN ISO 14555:2017 ve AWS D1.6/D1.6M: 2017, Madde 9.7.1
7	**Kaynak çapı düşük, normal olmayan girintili** 		**KABUL EDİLEMEZ:** Çapı düşük ya da normal olmayacak kadar çok girintili saplamalar. →Saplamayı **çıkarın ve yeni bir saplama kullanın.**	Kaynak Kodu (H-Kodu) ayarını kontrol edin. Burada verilen yüzey hazırlık gerekliliklerine uyun: Tablo 2. Yüzey hazırlığı ve saplamada herhangi bir kirlenme olmadığından emin olun.	EN ISO 14555:2017, Tablo A.5, No. 2 ve AWS D1.6/D1.6M: 2017, Madde 9.7.1

No	Şema	Örnek görüntüler	Değerlendirme	Önerilen düzeltme işlemi	Bunu tamamlar
8	**Alette F-Kodu gösteriliyor** 		**KABUL EDİLEMEZ:** Kaynak sonrası F-Kodunun gösterildiği saplamalar. → **Burada belirtilen eylemleri gerçekleştirin:**Tablo 6	Tablo 6'da belirtilen F-Kodlarına göre düzeltici eylemler.	

Tablo 5: Kaplamasız çelik üzerine kaynaklanan F-BT saplamaları için görsel inceleme kataloğu (yüzey aleti FX 3-ST d14)

No	Şema	Örnek görüntüler	Değerlendirme	Önerilen düzeltme işlemi	Bunu tamamlar
1	**Kaynak pimi etrafında düzgün, tam halka** 		**KABUL EDİLEBİLİR**	Yok.	EN ISO 14555:2017, Tablo A.5, No. 4
2	**Merkezi olmayan saplama** 		**KABUL EDİLEMEZ:** Yuvarlak hazırlığa merkezi olmayan şekilde kaynaklanmış saplamalar. →Saplamayı **çıkarın ve yeni bir saplama kullanın.**	Saplamanın ucunu, yüzey hazırlığının ortasına merkezleyin. FX 3-HT el aletini merkezli, dik ve sakin tutun.	EN ISO 14555:2017, Tablo A.5, No. 4
3	**>2° eğimli saplama** 		**KABUL EDİLEMEZ:** >2° eğimli saplamalar. →Saplamayı **çıkarın ve yeni bir saplama kullanın.**	Kaynaklama sırasında el aletini dik ve sıkı tutun. Yüzey hazırlığının ana malzeme yüzeyine paralel olduğundan emin olun.	EN ISO 14555:2017, Tablo A.5, No. 4
4	**Tek taraflı bağlantı, kaynak damlası dışarı çıkmış** 		**KABUL EDİLEMEZ:** Tek taraflı kaynak bağlantısı. → Kaynaklanan saplamayı **çıkarın ve yeni bir saplama kullanın.**	Tablo 2'de verilen yüzey hazırlık gerekliliklerine uyun. Taban bağlaması, saplama ve kenar boşluğu gerekliliklerine uyun.	EN ISO 14555:2017, Tablo A.5, No. 4 ve AWS D1.6/D1.6M: 2017, Madde 9.7.1

No	Şema	Örnek görüntüler	Değerlendirme	Önerilen düzeltme işlemi	Bunu tamamlar
5	**Kaynağın etrafında is var** 		**KABUL EDİLEMEZ:** Kaynağın etrafında is olan saplamalar. → Kaynaklanan saplamayı **çıkarın ve yeni bir saplama kullanın.**	Tablo 3'te verilen yüzey hazırlık gerekliliklerine uyun. Yüzey hazırlığı ve saplamada herhangi bir kirlenme olmadığından emin olun.	Tablo A.5, No. 3 ve 4, EN ISO 14555:2017
6	**Sıçramalar veya kaynak parçaları** 		**KABUL EDİLEMEZ:** Kaynağın etrafında sıçrama ya da kaynak parçaları olan saplamalar. → Kaynaklanan saplamayı **çıkarın ve yeni bir saplama kullanın.**	Tablo 3'te verilen yüzey hazırlık gerekliliklerine uyun. Yüzey hazırlığı ve saplamada herhangi bir kirlenme olmadığından emin olun.	Tablo A.5, No. 3 ve 5, EN ISO 14555:2017 ve AWS D1.6/D1.6M: 2017, Madde 9.7.1
7	**Kaynak çapı düşük, normal olmayan girintili** 		**KABUL EDİLEMEZ:** Çapı düşük ya da normal olmayacak kadar çok girintili saplamalar. →Saplamayı **çıkarın ve yeni bir saplama kullanın.**	Kaynak Kodu ayarını kontrol edin. Tablo 3'te verilen yüzey hazırlık gerekliliklerine uyun. Yüzey hazırlığı ve saplamada herhangi bir kirlenme olmadığından emin olun.	EN ISO 14555:2017, Tablo A.5, No. 2 ve AWS D1.6/D1.6M: 2017, Madde 9.7.1
8	**Alette F-Kodu gösteriliyor** 		**KABUL EDİLEMEZ:** Kaynak sonrası F-Kodunun gösterildiği saplamalar. → **Burada belirtilen eylemleri gerçekleştirin:**Tablo 6	Tablo 6'da belirtilen F-Kodlarına göre düzeltici eylemler.	

Tablo 6: F-Kodu listesi, saplamanın çıkarılmasını ya da incelenmesini gerektiren hata durumu

<table>
<tr><th>F-Kodu</th><th>Hata durumu</th><th>Gerekli eylem</th></tr>
<tr><td>F06</td><td>El aleti iç mekanik parçaları sıkışması.</td><td rowspan="5">1. Yöntem:
HAT 28 FX ile saplamayı çekme dayanımı yükünde test edin.
Dayanım yükü saplamanın Kaynak Koduna (H-Kodu) bağlıdır. Saplama dayanım yüküne dayanabilirse, kullanılabilir. Aksi takdirde tekrar takılmalıdır.
<table><tr><th>Kaynak kodu (H-Kodu)</th><th>kN (lbf) cinsinden çekme dayanımı yükü</th></tr><tr><td>H1</td><td>6 (1350)</td></tr><tr><td>H2</td><td>9 (2025)</td></tr><tr><td>H3</td><td>17 (3820)</td></tr><tr><td>H10</td><td>22 (4950)</td></tr></table>
2. Yöntem:
Saplamayı, test yapmadan çıkarın ve yeniden takın.</td></tr>
<tr><td>F07</td><td>Elektrik bağlantısında sorun var</td></tr>
<tr><td>F10</td><td>Saplamanın yerleşimi düzgün değil</td></tr>
<tr><td>F14</td><td>Operatör tarafından durdurulan işlem</td></tr>
<tr><td>F16</td><td>Nokta kirli</td></tr>
<tr><td>F17</td><td>İşlemden çıkıldı</td><td>Saplamayı çıkarın ve yeni bir saplama takın</td></tr>
</table>

- F-Kodlarının tekrarlanmasını önlemeye yönelik düzeltici eylemler için Kit kutusunun içindeki Etikete bakın.
- Burada belirtilmeyen F-Kodlarının sorun giderme işlemleri için Kit kutusunun içindeki Etikete bakın.
- F-BT'nin nasıl çıkarılacağı ve yeniden takılacağı ile ilgili öneriler F-BT onarım prosedüründe verilmektedir.

DANH MỤC KIỂM TRA TRỰC QUAN HILTI F-BT

Kiểm tra và đánh giá trực quan bu-lông Hilti F-BT được chia làm hai phần.

Đầu tiên là kiểm tra bề mặt chuẩn bị (Bảng 2 và Bảng 3) trước khi hàn và thứ hai là kiểm tra chính việc hàn bu-lông F-BT (Bảng 4 và Bảng 5).

Mục đích của danh mục kiểm tra là nhằm đánh giá hình thức bên ngoài xem có thể hay không thể chấp nhận cho sử dụng.

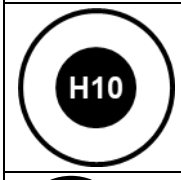
Các tiêu chí đánh giá hình thức bên ngoài của bu-lông bổ sung cho các yêu cầu của tiêu chuẩn EN ISO 14555:2017 Bảng A.5 và AWS D1.6 Khoản 9.7. Với việc sử dụng các tiêu chuẩn này làm cơ sở, tài liệu này đề cập đến các đặc điểm cụ thể của bu-lông hàn Hilti F-BT.

Danh mục kiểm tra áp dụng cho bề mặt chuẩn bị được lập riêng để đánh giá hình thức bên ngoài sau khi hoàn thành bề mặt chuẩn bị bằng cách sử dụng các dụng cụ chuẩn bị bề mặt Hilti FX 3-ST.

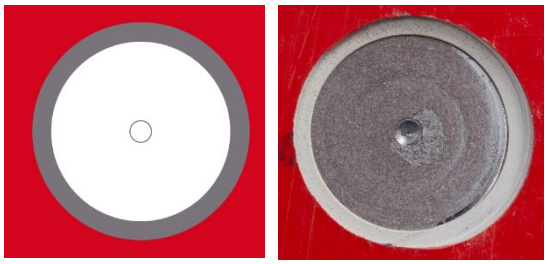
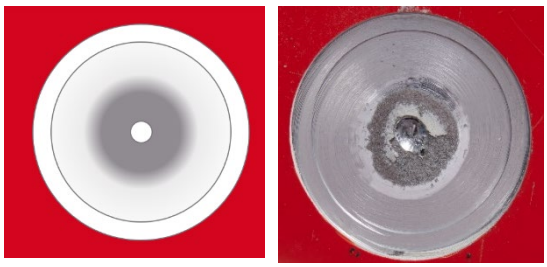
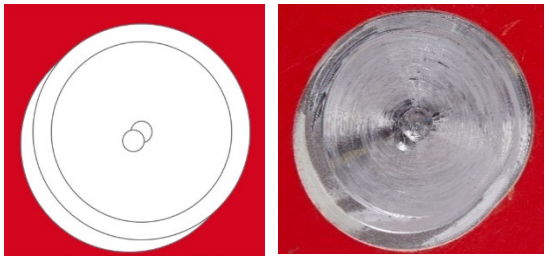
Phải sử dụng danh mục kiểm tra Hilti F-BT cho hồ sơ tiêu chuẩn quy trình hàn (WPQR/PQR) cũng như việc kiểm tra bu-lông trong khi kiểm soát quá trình, kiểm soát hàn sản xuất và giám sát sản xuất.

Bảng 1 giải thích cách đọc các phác họa sơ lược sẽ sử dụng trong danh mục này.

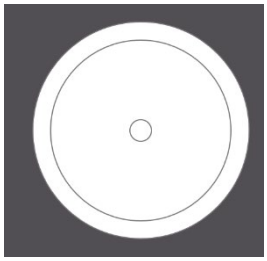
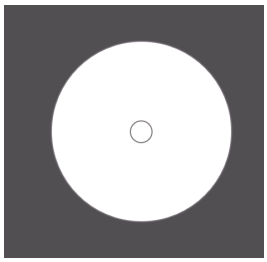
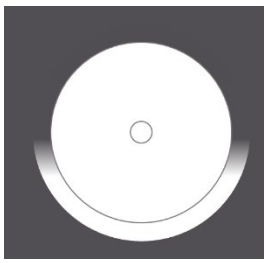
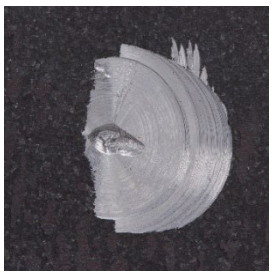
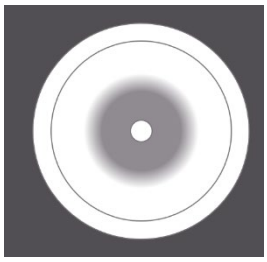
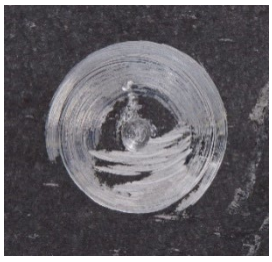
Bảng 1: Giải thích hình phác thảo

Hình phác thảo	Giải thích
Kiểm tra bề mặt chuẩn bị	
	Hình ảnh nhìn từ trên xuống của bề mặt chuẩn bị trên thép đã sơn phủ. Màu sơn phủ trong ví dụ này là màu đỏ. Trong cả hai hình phác thảo đều thể hiện vòng tròn bên ngoài. Hình phác thảo bên trái cho thấy "vòng tròn sáng bóng" ở bên ngoài. Trong khi đó hình phác thảo bên phải cho thấy vòng tròn có cặn bẩn và sẽ có màu mờ hơn. Vòng tròn nhỏ ở giữa mỗi hình phác thảo thể hiện phần lõm do đầu nhọn ở giữa dụng cụ chuẩn bị bề mặt tạo ra.
Kiểm tra bu-lông hàn	
	Hình ảnh nhìn từ trên xuống của F-BT được hàn vào vật liệu chính được chuẩn bị bằng dụng cụ chuẩn bị bề mặt FX 3-ST d20.
	Hình ảnh nhìn từ trên xuống của F-BT được hàn vào vật liệu chính được chuẩn bị bằng dụng cụ chuẩn bị bề mặt FX 3-ST d14.

Bảng 2: Bề mặt chuẩn bị của vật liệu chính đã sơn phủ bằng dụng cụ chuẩn bị bề mặt FX 3-ST d20

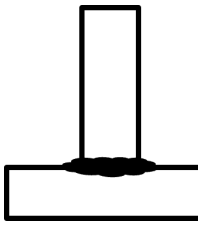
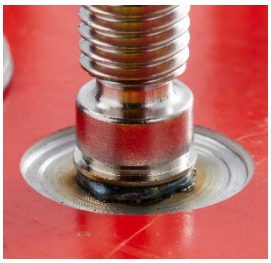
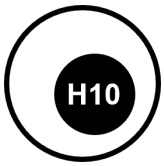
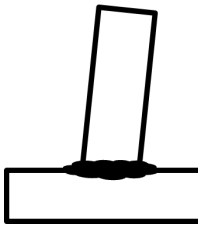
STT	Hình phác thảo	Hình ảnh ví dụ	Đánh giá	Biện pháp khắc phục được đề xuất
1	**Vòng tròn trống không và sáng bóng**		**CÓ THỂ CHẤP NHẬN**	Không có
2	**Cặn bẩn trên vòng tròn bên ngoài**		**KHÔNG THỂ CHẤP NHẬN:** Cặn bẩn trên vòng tròn bên ngoài.	Tiếp tục quá trình chuẩn bị cho đến khi khấc chặn (vòng tròn bên ngoài) sạch khắp 360°. Thay dụng cụ chuẩn bị bề mặt nếu cần.
3	**Bề mặt chuẩn bị bị nghiêng**		**KHÔNG THỂ CHẤP NHẬN:** Một bên có cặn bẩn và bề mặt chuẩn bị bị nghiêng.	Tiếp tục quá trình chuẩn bị và nghiêng máy khoan một chút sang bên mà thấy có cặn bẩn để loại bỏ các cặn bẩn này và tạo bề mặt bằng phẳng để gắn bu-lông.
4	**Bề mặt chuẩn bị không bằng phẳng**		**KHÔNG THỂ CHẤP NHẬN:** Có cặn bẩn trên bề mặt.	Khi chuẩn bị bề mặt, hãy giữ và ấn dụng cụ thẳng xuống bề mặt đó. Tránh lắc lư dụng cụ chuẩn bị bề mặt.
5	**Bề mặt chuẩn bị không đối xứng hoặc bị lộ hai bề mặt**		**KHÔNG THỂ CHẤP NHẬN:** Bề mặt chuẩn bị không đối xứng và để lộ hai vòng tròn.	Không dùng bề mặt chuẩn bị không đối xứng để hàn. Tạo bề mặt chuẩn bị ở vị trí mới. Ở lần tiếp theo, hãy giữ và ấn dụng cụ thẳng xuống một cách chắc chắn trong quá trình chuẩn bị.

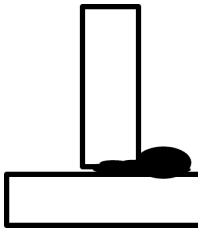
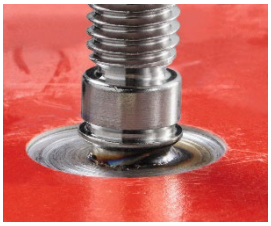
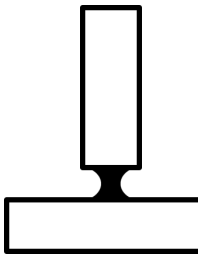
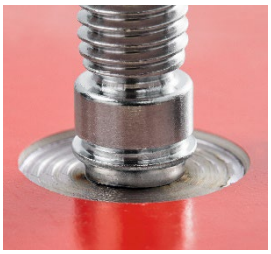
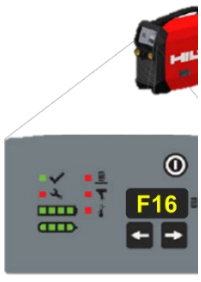
Bảng 3: Bề mặt chuẩn bị vật liệu chính chưa sơn phủ bằng dụng cụ chuẩn bị bề mặt FX 3-ST d14

STT	Hình phác thảo	Hình ảnh ví dụ	Đánh giá	Biện pháp khắc phục được đề xuất
1	**Vòng tròn trống không và sáng bóng** 		**CÓ THỂ CHẤP NHẬN**	Không có
2	**Cặn bẩn trên vòng tròn bên ngoài** 		**KHÔNG THỂ CHẤP NHẬN:** Cặn bẩn trên vòng tròn.	Tiếp tục quá trình chuẩn bị cho đến khi khấc chặn (vòng tròn bên ngoài) sạch khắp 360°. Thay dụng cụ chuẩn bị bề mặt nếu cần.
3	**Bề mặt chuẩn bị bị nghiêng** 		**KHÔNG THỂ CHẤP NHẬN:** Một bên có cặn bẩn và bề mặt chuẩn bị bị nghiêng.	Tiếp tục quá trình chuẩn bị và nghiêng máy khoan một chút sang bên mà thấy có cặn bẩn để loại bỏ các cặn bẩn này và tạo bề mặt bằng phẳng để gắn bu-lông.
4	**Bề mặt chuẩn bị không bằng phẳng** 		**KHÔNG THỂ CHẤP NHẬN:** Có cặn bẩn trên bề mặt.	Khi chuẩn bị bề mặt, hãy giữ và ấn dụng cụ thẳng xuống bề mặt đó. Tránh lắc lư dụng cụ chuẩn bị bề mặt.

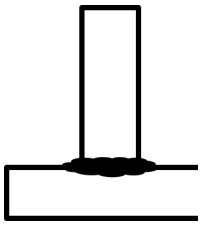
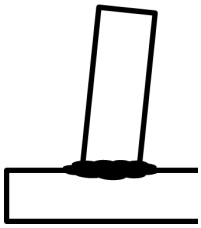
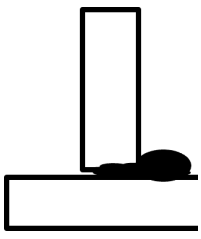
STT	Hình phác thảo	Hình ảnh ví dụ	Đánh giá	Biện pháp khắc phục được đề xuất
5	**Bề mặt chuẩn bị không đối xứng hoặc bị lộ hai bề mặt** 		**KHÔNG THỂ CHẤP NHẬN:** Bề mặt chuẩn bị không đối xứng hoặc bị lộ hai bề mặt.	Không dùng bề mặt chuẩn bị không đối xứng để hàn. Tạo bề mặt chuẩn bị ở vị trí mới. Ở lần tiếp theo, hãy giữ và ấn dụng cụ thẳng xuống một cách chắc chắn trong quá trình chuẩn bị.

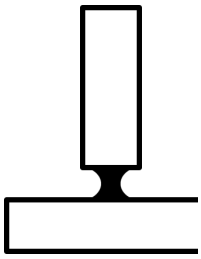
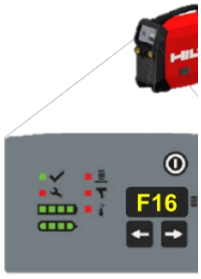
Bảng 4: Danh mục kiểm tra trực quan cho bu-lông F-BT được hàn vào thép đã sơn phủ (dụng cụ chuẩn bị bề mặt FX 3-ST d20)

STT	Hình phác thảo	Hình ảnh ví dụ	Đánh giá	Biện pháp khắc phục được đề xuất	Bổ sung cho
1	**Vành hoàn chỉnh thông thường** 		**CÓ THỂ CHẤP NHẬN**	Không có.	Bảng A.5, Số 4 của EN ISO 14555:2017
2	**Bu-lông lệch tâm** 		**KHÔNG THỂ CHẤP NHẬN:** Bu-lông được hàn lệch tâm vào bề mặt chuẩn bị hình tròn. □ **Tháo ra và gắn lại** bu-lông	Định tâm phần đầu nhọn của bu-lông vào giữa bề mặt chuẩn bị. Giữ chắc dụng cụ cầm tay FX 3-HT ở chính giữa, vuông góc với bề mặt.	Bảng A.5, Số 4 của EN ISO 14555:2017
3	**Bu-lông bị nghiêng >2°** 		**KHÔNG THỂ CHẤP NHẬN:** Bu-lông bị nghiêng >2°. □ **Tháo ra và gắn lại** bu-lông	Giữ chắc dụng cụ cầm tay vuông góc với bề mặt trong quá trình hàn. Đảm bảo bề mặt chuẩn bị song song với bề mặt vật liệu chính.	Bảng A.5, Số 4 của EN ISO 14555:2017

STT	Hình phác thảo	Hình ảnh ví dụ	Đánh giá	Biện pháp khắc phục được đề xuất	Bổ sung cho
4	**Mối hàn nằm một bên, giọt hàn nhô ra** 		**KHÔNG THỂ CHẤP NHẬN:** Mối hàn nằm một bên. □ **Kiểm tra hoặc tháo** bu-lông đã hàn	Tuân thủ các yêu cầu về bề mặt chuẩn bị trong Bảng 2. Tuân thủ các yêu cầu về khoảng cách giữa kẹp đế, bu-lông và phần mép.	Bảng A.5, Số 4 của EN ISO 14555:2017 và Khoản 9.7.1 của AWS D1.6/D1.6M: 2017
5	**Muội than quanh mối hàn** 		**KHÔNG THỂ CHẤP NHẬN:** Bu-lông có muội than quanh mối hàn. □ **Kiểm tra hoặc tháo** bu-lông đã hàn	Tuân thủ các yêu cầu về bề mặt chuẩn bị trong Bảng 2. Đảm bảo rằng bề mặt chuẩn bị và bu-lông không bị bẩn.	Bảng A.5, Số 3 và 4 của EN ISO 14555:2017
6	**Vẩy hàn bắn ra hoặc tia lửa** 		**KHÔNG THỂ CHẤP NHẬN:** Bu-lông có vẩy hàn bắn ra hoặc tia lửa quanh mối hàn. □ **Kiểm tra hoặc tháo** bu-lông đã hàn	Tuân thủ các yêu cầu về bề mặt chuẩn bị trong Bảng 2. Đảm bảo rằng bề mặt chuẩn bị và bu-lông không bị bẩn.	Bảng A.5, Số 3 và 5 của EN ISO 14555:2017 và Khoản 9.7.1 của AWS D1.6/D1.6M: 2017
7	**Giảm đường kính mối hàn, khoảng hở bất thường** 		**KHÔNG THỂ CHẤP NHẬN:** Bu-lông đã giảm đường kính hoặc khoảng hở cao bất thường. □ **Tháo ra và gắn lại** bu-lông	Kiểm tra thiết lập Mã hàn (Mã H). Tuân thủ các yêu cầu về bề mặt chuẩn bị trong Bảng 2. Đảm bảo rằng bề mặt chuẩn bị và bu-lông không bị bẩn.	Bảng A.5, Số 2 của EN ISO 14555:2017 và Khoản 9.7.1 của AWS D1.6/D1.6M: 2017
8	**Mã lỗi hiển thị trên dụng cụ** 		**KHÔNG THỂ CHẤP NHẬN:** Bu-lông có Mã lỗi hiển thị sau khi hàn. □ **Thực hiện theo các biện pháp cần thiết trong** Bảng 6	Biện pháp khắc phục tùy thuộc vào Mã lỗi được liệt kê trong Bảng 6.	

Bảng 5: Danh mục kiểm tra trực quan cho bu-lông F-BT được hàn vào thép chưa sơn phủ (dụng cụ chuẩn bị bề mặt FX 3-ST d14)

STT	Hình phác thảo	Hình ảnh ví dụ	Đánh giá	Biện pháp khắc phục được đề xuất	Bổ sung cho
1	**Vành hoàn chỉnh thông thường quanh chân hàn** 		**CÓ THỂ CHẤP NHẬN**	Không có.	Bảng A.5, Số 4 của EN ISO 14555:2017
2	**Bu-lông lệch tâm** 		**KHÔNG THỂ CHẤP NHẬN:** Bu-lông được hàn lệch tâm vào bề mặt chuẩn bị hình tròn. □ **Tháo ra và gắn lại** bu-lông	Định tâm phần đầu nhọn của bu-lông vào giữa bề mặt chuẩn bị. Giữ chắc dụng cụ cầm tay FX 3-HT ở chính giữa, vuông góc với bề mặt.	Bảng A.5, Số 4 của EN ISO 14555:2017
3	**Bu-lông bị nghiêng >2°** 		**KHÔNG THỂ CHẤP NHẬN:** Bu-lông bị nghiêng >2°. □ **Tháo ra và gắn lại** bu-lông	Giữ chắc dụng cụ cầm tay vuông góc với bề mặt trong quá trình hàn. Đảm bảo bề mặt chuẩn bị song song với bề mặt vật liệu chính.	Bảng A.5, Số 4 của EN ISO 14555:2017
4	**Mối hàn nằm một bên, giọt hàn nhô ra** 		**KHÔNG THỂ CHẤP NHẬN:** Mối hàn nằm một bên. □ **Kiểm tra hoặc tháo** bu-lông đã hàn	Tuân thủ các yêu cầu về bề mặt chuẩn bị trong Bảng 2. Tuân thủ các yêu cầu về khoảng cách giữa kẹp đế, bu-lông và phần mép.	Bảng A.5, Số 4 của EN ISO 14555:2017 và Khoản 9.7.1 của AWS D1.6/D1.6M: 2017

STT	Hình phác thảo	Hình ảnh ví dụ	Đánh giá	Biện pháp khắc phục được đề xuất	Bổ sung cho
5	**Muội than quanh mối hàn** 		**KHÔNG THỂ CHẤP NHẬN:** Bu-lông có muội than quanh mối hàn. □ **Kiểm tra hoặc tháo** bu-lông đã hàn	Tuân thủ các yêu cầu về bề mặt chuẩn bị trong Bảng 3. Đảm bảo rằng bề mặt chuẩn bị và bu-lông không bị bẩn.	Bảng A.5, Số 3 và 4 của EN ISO 14555:2017
6	**Vẩy hàn bắn ra hoặc tia lửa** 		**KHÔNG THỂ CHẤP NHẬN:** Bu-lông có vẩy hàn bắn ra hoặc tia lửa quanh mối hàn. □ **Kiểm tra hoặc tháo** bu-lông đã hàn	Tuân thủ các yêu cầu về bề mặt chuẩn bị trong Bảng 3. Đảm bảo rằng bề mặt chuẩn bị và bu-lông không bị bẩn.	Bảng A.5, Số 3 và 5 của EN ISO 14555:2017 và Khoản 9.7.1 của AWS D1.6/D1.6M: 2017
7	**Giảm đường kính mối hàn, khoảng hở bất thường** 		**KHÔNG THỂ CHẤP NHẬN:** Bu-lông đã giảm đường kính hoặc khoảng hở cao bất thường. □ **Tháo ra và gắn lại** bu-lông	Kiểm tra thiết lập Mã hàn. Tuân thủ các yêu cầu về bề mặt chuẩn bị trong Bảng 3. Đảm bảo rằng bề mặt chuẩn bị và bu-lông không bị bẩn.	Bảng A.5, Số 2 của EN ISO 14555:2017 và Khoản 9.7.1 của AWS D1.6/D1.6M: 2017
8	**Mã lỗi hiển thị trên dụng cụ** 		**KHÔNG THỂ CHẤP NHẬN:** Bu-lông có Mã lỗi hiển thị sau khi hàn. □ **Thực hiện theo các biện pháp cần thiết trong** Bảng 6	Biện pháp khắc phục tùy thuộc vào Mã lỗi được liệt kê trong Bảng 6.	

Bảng 6: Danh sách Mã lỗi, trường hợp lỗi đòi hỏi phải tháo hay kiểm tra bu-lông

<table>
<tr><th>Mã lỗi</th><th>Trường hợp lỗi</th><th>Biện pháp cần thực hiện</th></tr>
<tr><td>F06</td><td>Bộ phận cơ học bên trong dụng cụ cầm tay bị kết dính</td><td rowspan="5">Thực hiện:
Kiểm tra bu-lông ở tải trọng đối chứng kéo đứt với HAT 28 FX.
Tải trọng đối chứng tùy thuộc vào Mã hàn (Mã H) của bu-lông. Nếu bu-lông chịu được tải trọng đối chứng, nghĩa là có thể sử dụng, nếu không thì phải gắn lại bu-lông.
<table><tr><th>Mã hàn (Mã H)</th><th>Tải trọng đối chứng kéo đứt tính bằng kN (lbf)</th></tr><tr><td>H1</td><td>6 (1350)</td></tr><tr><td>H2</td><td>9 (2025)</td></tr><tr><td>H3</td><td>17 (3820)</td></tr><tr><td>H10</td><td>22 (4950)</td></tr></table>
Hoặc:
Tháo và gắn lại bu-lông trực tiếp mà không kiểm tra.</td></tr>
<tr><td>F07</td><td>Kết nối điện kém</td></tr>
<tr><td>F10</td><td>Độ sâu đi xuống của bu-lông không đúng</td></tr>
<tr><td>F14</td><td>Người vận hành tạm dừng quá trình</td></tr>
<tr><td>F16</td><td>Vị trí hàn bị bẩn</td></tr>
<tr><td>F17</td><td>Quá trình bị hủy</td><td>Tháo ra và gắn lại bu-lông</td></tr>
</table>

- Để biết các biện pháp khắc phục nhằm tránh tái diễn Mã lỗi, hãy xem Nhãn dán bên trong hộp Bộ dụng cụ.
- Để biết cách khắc phục sự cố đối với các Mã lỗi không được liệt kê ở đây, hãy xem Nhãn dán bên trong hộp Bộ dụng cụ.
- Vui lòng xem đề xuất về cách tháo và gắn lại F-BT trong quy trình sửa chữa đối với F-BT.