

Top hammer tools failure analysis guide



For internal use



Top hammer tools

failure analysis guide

Contents

Foreword	5
Button bit failures	6
Cross bit failures	10
Extension rod failures	13
Guide tube failures	17
Drill tube failures	20
Shank adapter failures	22
Coupling sleeve failures	27
Tapered rod & integral steel failures	29

Top hammer tools

failure analysis guide

Foreword

Sandvik rock drilling tools are engineered to give optimal long-life performance under hard drilling conditions. Our customers' associate Sandvik tools with high performance and reliability. On rare occasions manufacturing errors can compromise the service life of our tools and lead to premature failure.

Most of the failures are however a direct result of improper working practices or incorrect service. In the vast majority of cases it is operating procedures or field conditions that are causing the failure. It is suggested that the following be inspected for correct operation before considering product defects.

- **Rig settings**
 - *Percussion pressure*
 - *Feed pressure*
 - *Rotation pressure and speed*
- **Flushing**
- **Lubrication**
- **Material handling, including proper bit grinding**

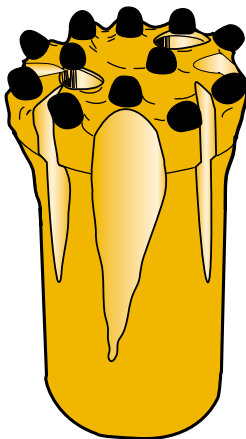
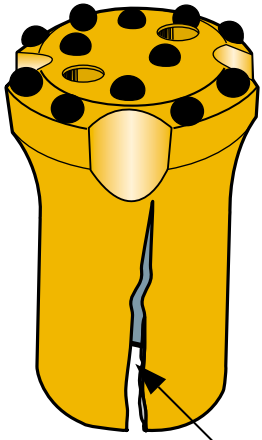
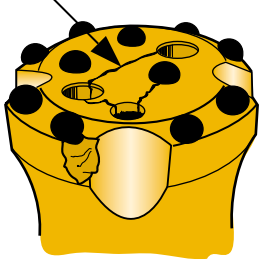
Hole misalignment through poorly serviced rigs, bad collaring and wandering holes are the foremost factors contributing to stress in the drill string and subsequent tool failure. It is imperative that all reasonable measures are taken to drill straight holes.

Sandvik tools are designed and manufactured within strict tolerances. Any mixing with competitors products can jeopardise their integrity. Cemented carbide failures are generally the result of poor grinding procedures or continuing to drill with excessive wear flats on the inserts. The use of dated or incorrectly serviced grinding equipment can grind bits outside their specified tolerances.

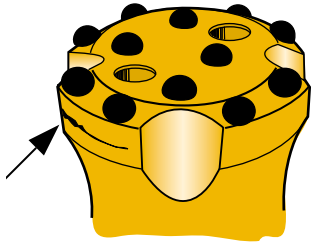
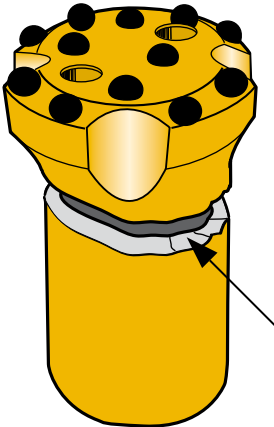
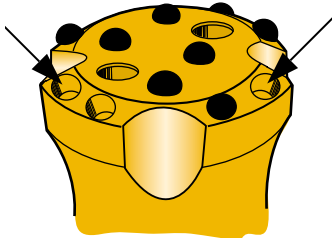
It is important to check grinding practices to ensure that they are carried out in a competent manner. On many occasions it has been observed that dry grinding wheels have been used for wet grinding which will almost certainly lead to carbide failure. In non-wearing rock formations 'snakeskin' fatigue is a primary factor in carbide failure if regular grinding intervals are not employed.

This guide illustrates the main types of failure in rock tool products. Listed with each type of failure are the probable causes of the failure and some recommended actions to prevent further problems. If the failure type or cause cannot be found within this guide it is recommended that you contact Sandviken.

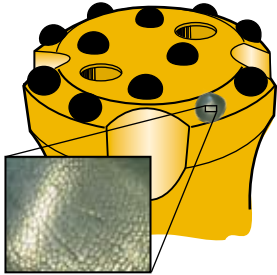
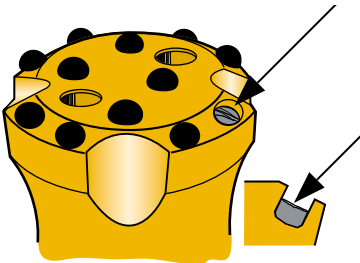
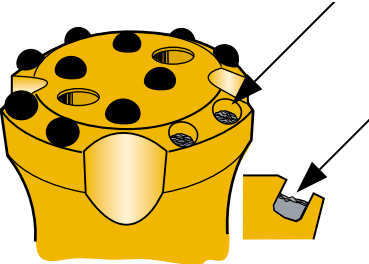
A. BUTTON BIT FAILURES

Failure mode	Probable cause	Recommended action
<p>A:1 BODY WASH</p> 	<p>Excessive flushing volume</p> <p>Drilling with excessive flushing volume can in some rock cause sand-blasting of the steel and too big protrusion and breakage of the buttons</p>	<p>Reduce flushing volume</p> <p>Shorten grinding intervals</p>
<p>A:2 SPLIT SKIRT</p>  <p><i>Error code B2</i></p>	<p>Drilling with the thread open</p> <p>Wrong procedure when loosening the bit</p> <p>Drilling with too worn threads</p>	<p>Increase feed force. Tighten joints before percussion.</p> <p>Loosen bit with impact mechanism while seated firmly on face or at bottom of hole. Use little feed and no rotation, or use special wrench</p> <p>Change to new rods. Make sure specified rods are used</p>
<p>A:3 STEEL CRACK BETWEEN BUTTON-OR FLUSHING HOLES</p>  <p><i>Error code F1f</i></p>	<p>Final failure when drilling a bit with big buttons (Heavy Duty) in non wearing rock like limestone</p> <p>Manufacturing error. Inferior button hole-drilling precision</p>	<p>Change to bit with other design</p> <p>Return for analysis</p>

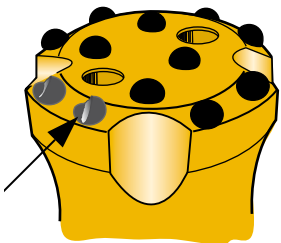
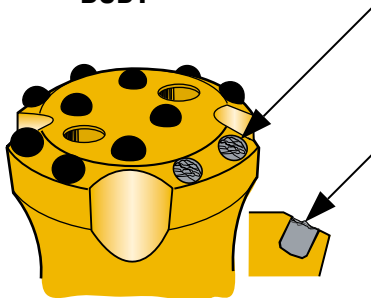
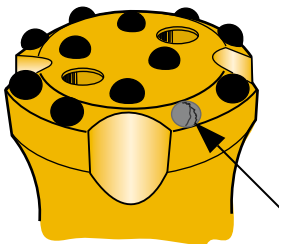
A. BUTTON BIT FAILURES

Failure mode	Probable cause	Recommended action
<p>A:4 STEEL CRACK STARTING FROM A BUTTON HOLE BOTTOM</p>  <p><i>Error code F1b</i></p>	<p>Steel fatigue</p> <p>Manufacturing error. Inferior button hole-drilling precision</p>	<p>Normal final failure with long service life</p> <p>The bit is worn out</p> <p>Return for analysis</p>
<p>A:5 SKIRT RING-OFF</p>  <p><i>Error code B1</i></p>	<p>Excessive rotational speed applied to stuck bit</p> <p>Bad collaring practices</p> <p>Corrosion</p> <p>Hammering on bit to break connection</p> <p>Excessive back hammering</p> <p>Too low rock resistance</p> <p>Fatigue</p>	<p>Apply minimal amount of hammer pressure to free bit before increasing rotation speed</p> <p>Reduce percussion and feed when collaring</p> <p>Improve storage practices. Neutralise flushing agent</p> <p>Loosen bit with impact mechanism while seated firmly against the rock. Use little feed and no rotation, or use special wrench</p> <p>Use retract bit</p> <p>Reduce impact power</p> <p>Normal failure with long life</p>
<p>A:6 LOST BUTTONS</p> 	<p>Free hammering</p> <p>Inadequate feed pressure</p> <p>Scaling with bit</p> <p>Incorrect size correlation between button and button hole</p>	<p>Do not engage full percussions unless the bit is firmly seated againsts rock. Use reduced percussion when collaring on uneven surfaces</p> <p>Increase feed pressure</p> <p>Use proper scaling tool</p> <p>Return for analysis</p>

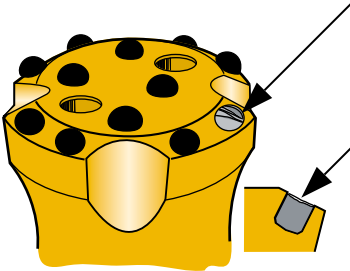
A. BUTTON BIT FAILURES

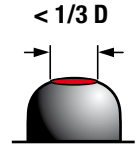
Failure mode	Probable cause	Recommended action
<p>A:7 SNAKESKIN OR MICRO-CRACKS IN CEMENTED CARBIDE</p>  <p><i>Error code S9</i></p>	<p>Drilling in non-abrasive rock creates micro-fractures in the carbide sometimes looking like snake skin</p> <p>The rock leaves a shiny surface on the buttons and a fatigue in the surface of the cemented carbide, leading to button failure</p>	<p>Earlier regrinding even if there are no or small wear flats</p> <p>Use a softer carbide grade</p>
<p>A:8 BUTTONS SHEARED-OFF UNDER BODY LEVEL</p>  <p><i>Error code S7u</i></p>	<p>Excessive button protrusion through incorrect grinding or steel wash. Protrusion greater than 3/4 of the button diameter may not provide sufficient support to resist the tensile forces that the button may encounter.</p> <p>Incorrect size correlation between button and button hole</p>	<p>Shorten grinding intervals</p> <p>Return for analysis</p>
<p>A:9 BUTTONS CRUSHED INSIDE THE BIT BODY</p>  <p><i>Error code S4u</i></p>	<p>Bad collaring practices</p> <p>Anti-taper from abrasive rock</p> <p>Excessive button protrusion from incorrect grinding. Button protrusion greater than 3/4 of the button diameter will not provide sufficient support to resist the tensile forces that the buttons may encounter</p>	<p>Ensure the boom is secure. Start collaring with reduced impact, then full pressure once bit is embedded 300 mm in the rock</p> <p>Grind bit to original shape</p> <p>Ensure correct grinding procedures</p>

A. BUTTON BIT FAILURES

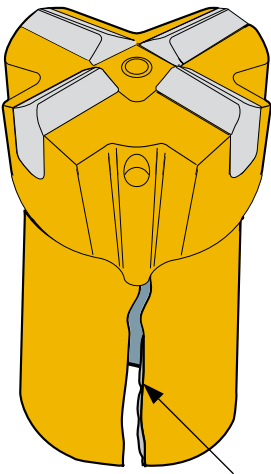
Failure mode	Probable cause	Recommended action
<p>A:10 BUTTON CHIPPED</p>  <p><i>Error code S3</i></p>	<p>Overdrilling</p> <p>Snakeskin. Overdrilling in soft, non-abrasive rock leaves a shiny surface on the buttons</p> <p>Button carbide is too hard</p> <p>Button not in contact with virgin material on impact</p>	<p>Shorten grinding intervals. Regrind when the wear flats are max. 1/3 of the button diameter</p> <p>Regularly inspect the bits and grind to remove micro-cracks from the surface of the carbides</p> <p>Choose softer or tougher grade of carbide</p> <p>Increase rotation speed</p>
<p>A:11 BUTTONS CRUSHED DOWN TO LEVEL OF BIT BODY</p>  <p><i>Error code S4</i></p>	<p>Snakeskin. Overdrilling in soft, non-abrasive rock leaves a shiny surface on the buttons and a fatigue in the surface of the cemented carbide, looking like snakeskin</p> <p>Overdrilling</p> <p>Incorrect grade of carbide</p> <p>Incorrect grinding procedures</p>	<p>Regularly inspect the bits and regrind regularly although the buttons seem not worn, just polished, to remove micro-cracks from the surface of the carbides</p> <p>Shorten grinding intervals</p> <p>Change carbide grade. See product catalogue or bit selection guide</p> <p>Dry grinding can result in snakeskin fatigue. Employ wet grinding</p>
<p>A:12 BUTTON CRACKED</p>  <p><i>Error code S1</i></p>	<p>Overdrilling</p> <p>Snakeskin</p> <p>Incorrect grinding procedures</p> <p>Button carbide is too hard</p>	<p>Regrind when the wear flats are max 1/3 of the button diameter</p> <p>Regularly inspect the bits and grind to remove micro-cracks from the surface of the carbide</p> <p>Dry grinding can give snakeskin fatigue. Employ wet grinding</p> <p>Choose softer or tougher grade of carbide</p>

A. BUTTON BIT FAILURES

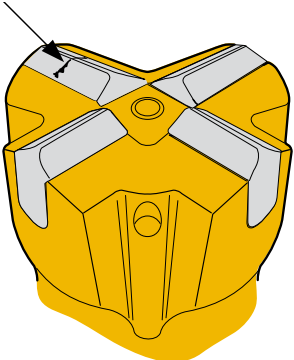
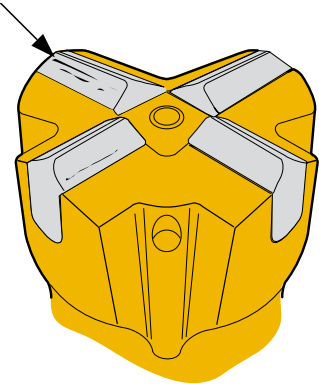
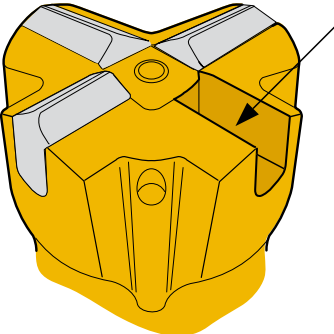
Failure mode	Probable cause	Recommended action
A:13 TOP OF BUTTON SHEARED OFF LEVEL WITH BODY  <i>Error code S7</i>	Overdrilling	Shorten grinding intervals. Regrind when the wear flats are max 1/3 of the button diameter
	Drilling into metal	Ensure correct drilling practices
	Snakeskin	Regularly inspect the bits and grind to remove micro-cracks from the surface of the cemented carbide
	Excessive button protrusion through incorrect grinding. Protrusions greater than 3/4 of the button diameter will not provide sufficient support to resist the tensile forces that the buttons may encounter	Shorten grinding intervals



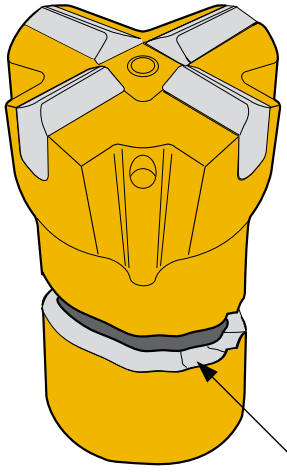
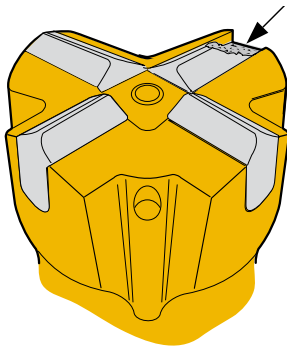
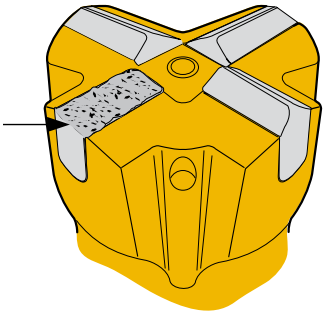
B. CROSS BIT FAILURES

Failure mode	Probable cause	Recommended action
B:1 SPLIT SKIRT (taper bits)  <i>Error code B2</i>	Taper mismatch or worn taper	Use a taper gauge to check taper angle. Change to proper bits
	Removing a bit with a hammer or miner's wrench	Utilise a proper knock-off block when removing bit

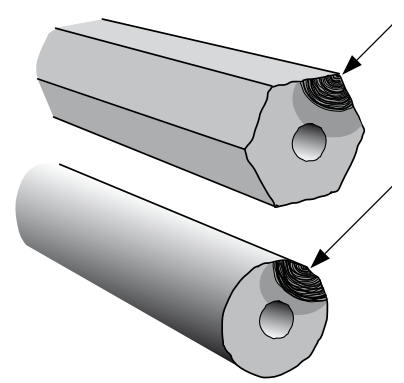
B. CROSS BIT FAILURES

Failure mode	Probable cause	Recommended action
<p>B:2 TRANSVERSAL CRACK</p>  <p><i>Error code S1</i></p>	<p>Overheating from improper grinding</p> <p>Anti-taper from abrasive rock</p> <p>Grinding scratches due to wrong grinding wheel</p>	<p>Regrind bit to its original shape. Follow proper bit grinding procedures</p> <p>Shorten grinding intervals</p> <p>Check grinding procedures and grinding wheel</p>
<p>B:3 LONGITUDINAL CRACKS</p>  <p><i>Error code S5</i></p>	<p>Overheating from improper grinding</p> <p>Carbide grade too hard</p>	<p>Regrind bit to its original shape. Follow proper bit grinding procedures</p> <p>Select a bit with a softer, tougher grade of carbide</p>
<p>B:4 WHOLE INSERT LOST</p>  <p><i>Error code L1</i></p>	<p>Brazed joint fatigued</p> <p>Inadequate feed pressure</p> <p>Braze failure</p>	<p>Normal failure with long life</p> <p>Increase feed pressure</p> <p>Return for analysis</p>

B. CROSS BIT FAILURES

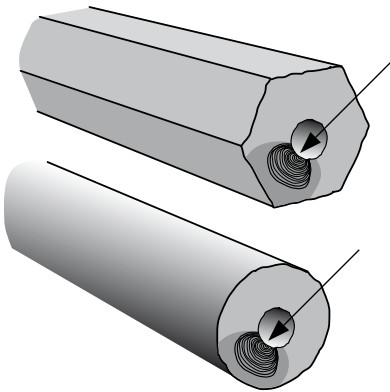
Failure mode	Probable cause	Recommended action
<p>B:5 SKIRT RING-OFF (taper bits)</p>  <p><i>Error code B1</i></p>	<p>Taper mismatch or worn taper</p> <p>Drilling with a broken taper</p> <p>Removing a bit with a hammer or miner's wrench</p> <p>Spinning</p> <p>Excessive wear of the skirt (over-drilled bit)</p>	<p>Use a taper gauge to check taper angle. Change to proper bits</p> <p>Change bit. Change to new drill steel and refurbish</p> <p>Remove bit using correct knock-off tools</p> <p>Adjust feed force</p>
<p>B:6 INSERT CORNER FRACTURED</p>  <p><i>Error code L2</i></p>	<p>Pinching by drilling into a hole that was drilled with a smaller bit</p> <p>Sharp corners or antitaper after grinding</p> <p>Removing a bit with a hammer or miner's wrench</p> <p>Drilling conditions creating snakeskin</p> <p>Bad collaring practices</p>	<p>Colour code bits by size to reduce the risk for negative gauge clearance</p> <p>Ensure proper grinding procedures</p> <p>Lower rotation and reduce hammer pressure</p> <p>Early regrinding even if there are no wear flats</p> <p>Reduce percussion and feed when collaring</p>
<p>B:7 INSERT SHATTERED</p>  <p><i>Error code S4</i></p>	<p>Incorrect grade of carbide</p> <p>Insufficient flushing</p> <p>Improper grinding</p>	<p>Change carbide grade, see product catalogue</p> <p>Increase flushing pressure</p> <p>Ensure proper grinding procedures</p>

C. EXTENSION ROD FAILURES

Failure mode	Probable cause	Recommended action
<p>C:1 SURFACE LAYER OF STEEL COMPROMISED BY A NICK OR DENT, FATIGUE ROSE ORIGINATING FROM THE SURFACE</p>	<p>Surface damage caused by worn out centraliser bushings</p> <p>Presence of a shiny steel surface near rose suggests martensite build up caused by rotation against steel</p>	<p>Replace centraliser</p>
 <p><i>Error code Kxxu/Nxxu</i></p>	<p>No centraliser used</p> <p>Using a sledge hammer on stuck steel</p> <p>Improper care and handling</p> <p>Wandering or drifting hole</p> <p>Excessive feed</p> <p>Bending due to misalignment</p>	<p>Ensure proper maintenance of rig</p> <p>Use a rod wrench to loosen</p> <p>Store rods in a rack when retracting drill string. Do not drop rods or store on the ground</p> <p>Employ guide tools and ballistic button bits</p> <p>Monitor feed pressure and tune to rock conditions</p>
		<p>Utilise alignment instruments to monitor hole orientation once then hole has been collared</p> <p>Replace wear pads on feed</p> <p>Make sure boom is stable under drilling and rig is fixed</p> <p>Avoid hanging rods when drilling in horizontal or inclined platforms. If rods are too long, consider using a travelling centraliser</p>
	<p>Poor drilling conditions. Drilling in voids, seams and/or broken conditions</p>	<p>Ajdjust drilling pressures and tune to rock conditions</p> <p>Avoid stuck in hole by adjusting drilling pressures and tune to rock conditions</p> <p>Use Retrac bits</p>
	<p>Feeder damaged when scaling in drifter tunnelling</p>	<p>Check feeder is not bent or twisted</p>

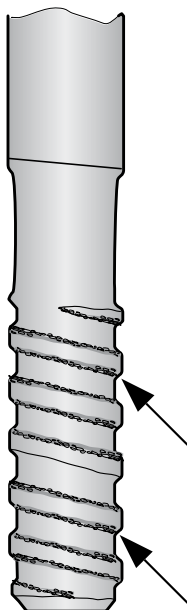
C. EXTENSION ROD FAILURES

Failure mode	Probable cause	Recommended action
C:2 ROD BREAKAGE CHARACTERISED BY A FATIGUE ROSE ORIGINATING FROM THE FLUSHING HOLE	Corrosion caused by corrosive flushing agents	Ensure that proper storage practices are being followed. Change components more frequently or neutralise flushing agents
	Insufficient rust treatment	Return for analysis
	Pores in flushing hole surface	Return for analysis



Error code Kxxi/Nxxi

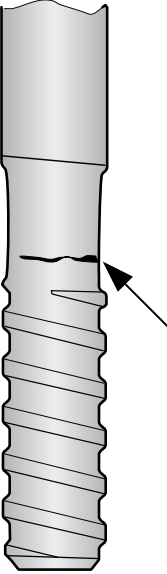
C:3 PITTING OR WEAR IN THE THREADS

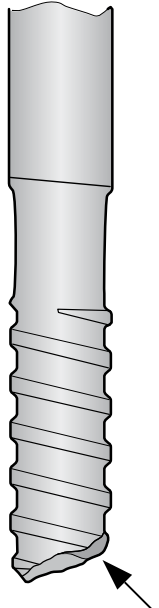


Error code A11

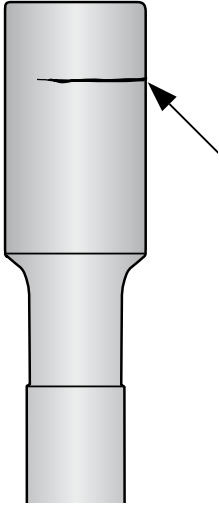
Overheated threads due to loose connection or hole deviation. Reflected percussive energy	Tune percussion and feed pressures to conditions (in most cases reduce percussion pressure and increase feed pressure). Use a ballistic button bit to help tighten drill string. If caused by hole deviation take steps to drill straighter holes
Free hammering	Do not engage full percussion unless the bit is firmly seated against rock. Use reduced percussion when collaring on uneven surfaces
Worn threads	Replace worn components. Do not put a worn rod on a new rod. Change out all rods together
Drilling with worn bits	Regrind the bit when the wear flats are max. 1/3 of the button diameter

C. EXTENSION ROD FAILURES

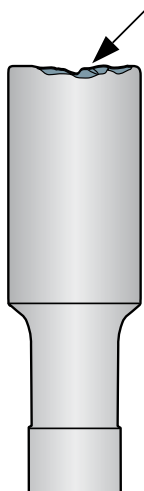
Failure mode	Probable cause	Recommended action
C:4 FAILURE AT THE BEGINNING OF THE THREAD OR WHERE THE COUPLING ENDS  <i>Error code Kxx</i>	Wandering or drifting hole	Employ guide tools and ballistic button bits
	Worn threads and/or coupling. M/M rods: migrating coupling (bridge worn out)	Replace worn components. Do not put a worn coupling on a new rod. Change out couplings and rods together
	Bending due to feed overpressure	Reduce feed pressure
	Bending due to misalignment	Utilise alignment instruments to monitor hole orientation once the hole has been collared. Replace wear pads on feed
	Heavy rotational loads caused by drilling with a worn bit giving high reflected energy	Regrind the bit when the wear flats are max. 1/3 of the button diameter
	Poor drilling conditions	Adjust drilling pressures and tune to rock conditions. Use Retrac bit
Continued percussion with stuck rod	Activate anti-jamming when drilling	

C:5 CHIP BROKEN OFF MALE THREAD  <i>Error code B4</i>	Inadequate feed pressure	Adjust pressure to conditions
	Worn coupling	Replace worn components. Do not put a worn coupling on a new rod
	Misalignment of rods with extension. Steel hitting coupling shoulder	Align drilling components with extension
	Drilling with worn bits	Maintain button bits in time
	Corrosion fatigue due to corrosive flushing water	Replace rod. Treat water

C. EXTENSION ROD FAILURES

Failure mode	Probable cause	Recommended action
<p>C:6 FAILURE ACROSS FEMALE THREAD SECTION</p>  <p><i>Error code B1</i></p>	<p>Hole deviation or feed misalignment</p> <p>Inadequate feed pressure. Starting point pittings on thread</p> <p>High torque from drilling with worn bits</p> <p>Mismatching threads</p> <p>Nick or dent in steel surface</p>	<p>Employ guide tools and ballistic button bits</p> <p>Monitor feed pressure and tune to conditions</p> <p>Regrind the bit when the wear flats are 1/3 of the button diameter</p> <p>Ensure all components are Sandvik manufactured. Do not "mix and match"</p> <p>Avoid hammering on connection. Use a wrench to loosen joints. Employ proper care and handling procedures</p>

C:7 FEMALE END IS CHIPPED, CRACKED AND/OR FLARED

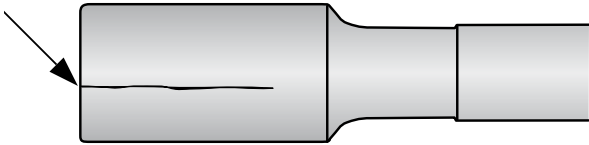


Error code B4

Tread joint not firmly tightened	Make sure threads are tight before engaging percussion
Misalignment of rods. Steel hitting coupling shoulder	Align drilling components with extension. Check and address any issue of hole deviation

C. EXTENSION ROD FAILURES

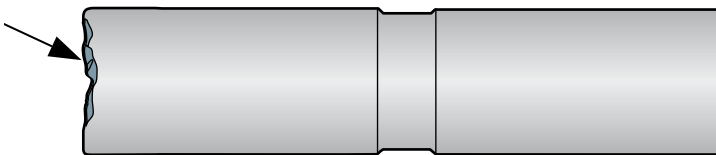
Failure mode	Probable cause	Recommended action
C:8 LONGITUDINAL CRACK IN FEMALE CONNECTION	Worn out threads	Replace components in time
	Hole deviation	Take action to drill straighter holes
	Misalignment of rods. Steel hitting coupling shoulder	Avoid excessive back hammering
	Drilling with loose thread joints	Increase the feed force
		Make sure that the joints are tightened before percussion
		Align drilling components with extension



Error code B2

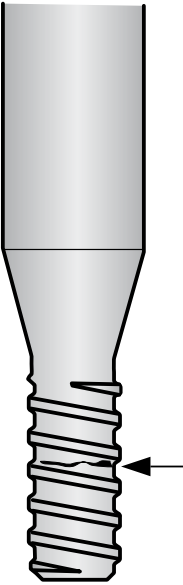
D. GUIDE TUBE FAILURES

Failure mode	Probable cause	Recommended action
D:1 FEMALE END IS CHIPPED, CRACKED AND/OR FLARED	Thread joint not firmly tightened	Make sure threads are tight before engaging percussion
	Misalignment of feed	Service affected equipment
	Starting percussion or rotation with end of the shank resting against the end of the coupling	Do not engage percussion or rotation if shank thread is not aligned inside coupling

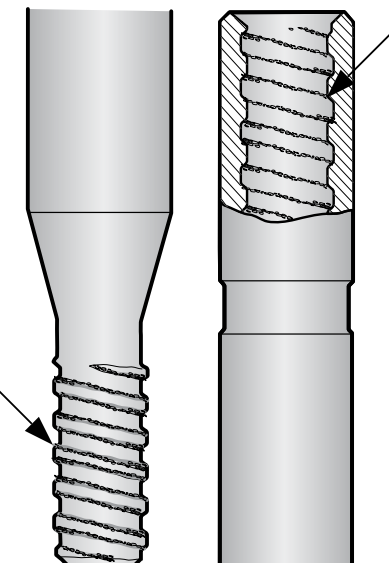


Error code B4

D. GUIDE TUBE FAILURES

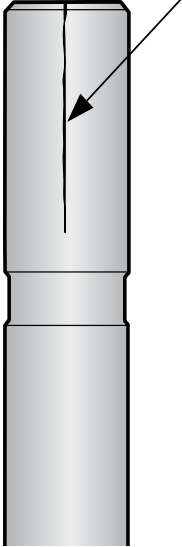
Failure mode	Probable cause	Recommended action
D:2 FAILURE ACROSS MALE THREAD SECTION 	Inadequate feed pressure	Monitor feed pressure and tune to conditions
	Breakage starting from pitting on thread	See D:3 below
	High torque caused by drilling with a worn bit	Regrind the bit when the wear flats are 1/3 of the button diameter
	Mismatching threads	Ensure all components are Sandvik manufactured. Do not "mix and match"
	Nick or dent in steel surface	Avoid hammering on bit. Employ proper care and handling
	Worn threads	Replace worn components

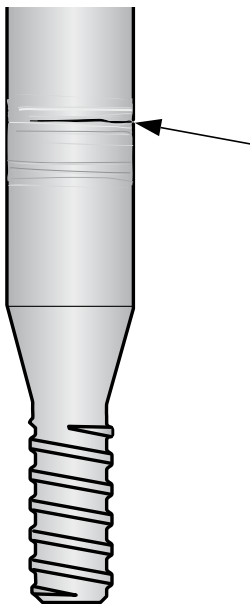
Error code Kxx

D:3 PITTING OR WEAR IN THE THREADS 	Reflected percussive energy	Adjust feed and percussion pressures to the rock conditions
	Free hammering	Do not engage full percussion unless the bit is firmly seated against rock. Use reduced percussion when collaring on uneven surfaces
	Worn threads	Replace worn components
	Drilling with worn bits	Regrind the bit when the wear flats are max. 1/3 of the button diameter

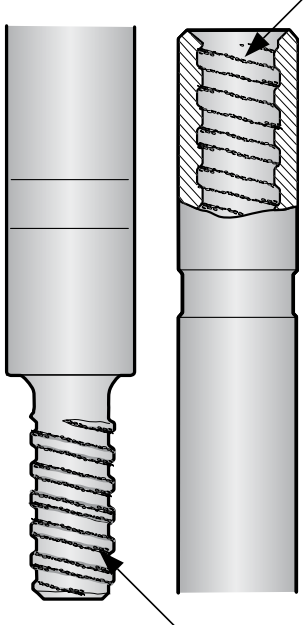
Error code A11

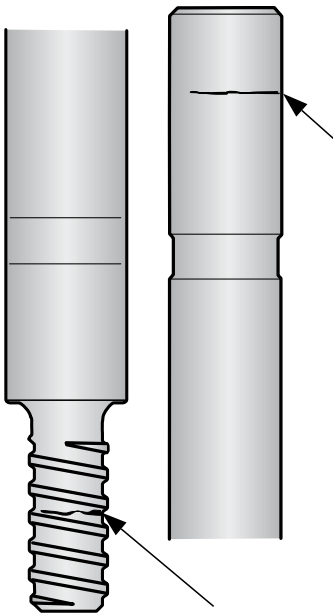
D. GUIDE TUBE FAILURES

Failure mode	Probable cause	Recommended action
<p>D:4 LONGITUDINAL CRACK IN FEMALE CONNECTION</p>  <p><i>Error code B2</i></p>	<p>Worn out threads</p> <p>Misalignment of rods. Steel hitting coupling shoulder</p> <p>Hammering with open threads gives wedging effect which can split the coupling</p>	<p>Replace components in time</p> <p>Service affected equipment</p> <p>Always make sure that connection is tight before hammering</p> <p>Avoid excessive back hammering</p>

<p>D:5 BREAK IN TUBE BODY</p>  <p><i>Error code Kxx/Nxx/B1</i></p>	<p>Surface damage caused by worn out centralisers</p> <p>Nick or dent in steel surface</p>	<p>Replace centralisers</p> <p>Avoid hammering on the tube. Employ proper care and handling</p>
--	--	---

E. DRILL TUBE FAILURES

Failure mode	Probable cause	Recommended action
E:1 PITTING OR WEAR ON THREADS  <p><i>Error code A11</i></p>	<p>Inadequate feed pressure and/or high percussion</p> <p>Cuttings in thread</p> <p>Corrosion caused by corrosive flushing agents</p>	<p>Adjust machine settings</p> <p>Keep flushing on when breaking pipe</p> <p>Change out components more frequently or neutralise flushing agent</p>

E:2 FAILURE IN MALE OR FEMALE THREAD SECTION  <p><i>Error code Kxx/Nxx</i></p>	<p>Misalignment of feed</p> <p>Hole deviation</p> <p>Hit on thread</p> <p>Corrosion caused by corrosive flushing agents</p>	<p>Make sure boom is aligned. Ensure good collaring practices</p> <p>Employ Retrac bits with ballistic buttons</p> <p>Ensure good rod handling practices</p> <p>Change components more frequently or neutralise flushing agent</p>
---	---	--

E. DRILL TUBE FAILURES

Failure mode	Probable cause	Recommended action
E:3 BREAK IN THREAD CLEARANCE	<p>Corrosion caused by corrosive flushing agents</p> <p>Misalignment of tube during friction welding</p>	<p>Change out components more frequently or neutralise flushing agent</p> <p>Return for analysis</p>

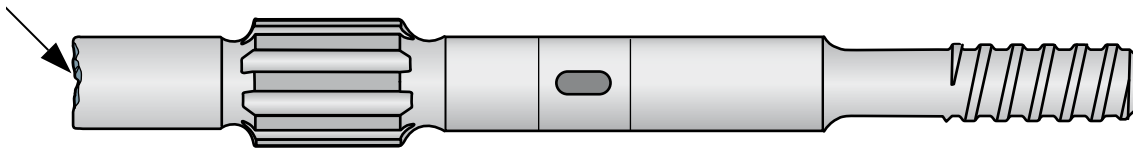
Error code B1

E:4 BREAK IN TUBE	<p>Friction martensite from worn out centraliser jaws</p> <p>Misalignment of feed</p> <p>Hole deviation</p> <p>Nick on tube</p>	<p>Change centraliser jaws</p> <p>Make sure boom is aligned. Ensure good collaring practices</p> <p>Employ Retrac bits with ballistic buttons</p> <p>Ensure good rod handling practices</p>
--------------------------	---	---

Error code B1

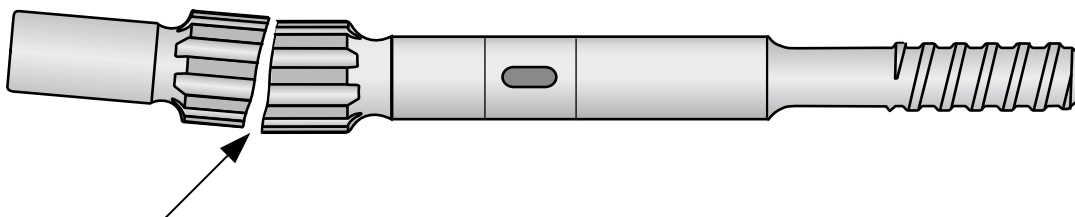
F. SHANK ADAPTER FAILURES

Failure mode	Probable cause	Recommended action
F:1 IMPACT MARKS, CHIPPED OR RIVETED END	Misalignment due to worn out bushings	Replace worn components in rock drill.
	Damaged piston	Replace piston Service affected equipment Service rock drill



Error code C2

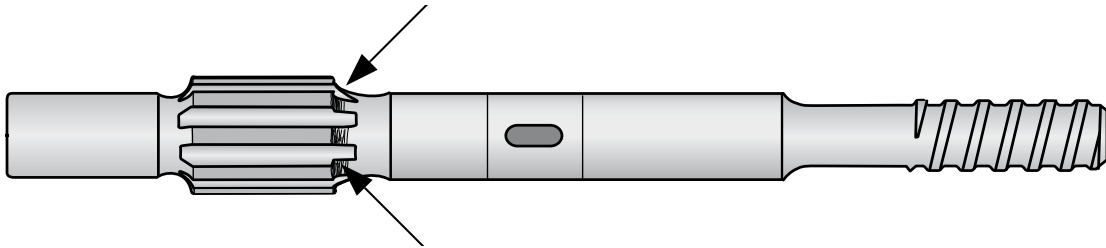
F:2 FAILURE ACROSS SPLINES	Poor or no lubrication	Ensure functioning lubrication
	Wrong or contaminated shank lubrication oil	Change to correct oil
	Stuck rod in broken rock and/or excessive back hammering	Use Retrac bits and activate anti-jammig when drilling
	Worn out chuck coupling	Replace worn components
	High rotational torque	Adjust drilling pressures
	Overdrilling bits	Regrinding should be done when the wear flats are max. 1/3 of the button diameter
	Inadequate feed pressure	Monitor coupling temperatures and adjust feed pressures according to recommendations



Error code Nxx

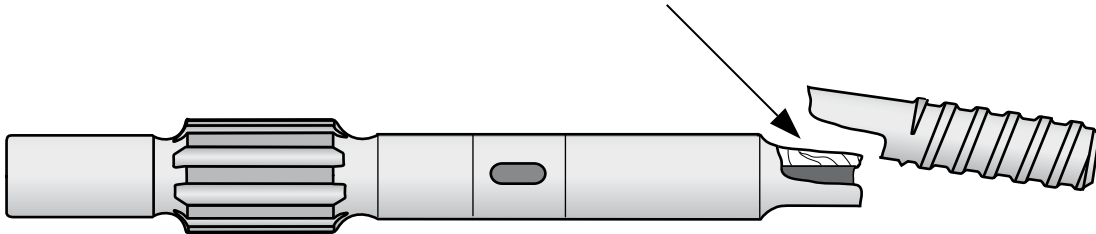
F. SHANK ADAPTER FAILURES

Failure mode	Probable cause	Recommended action
F:3 WEAR ON BOTTOM OF SPLINE SHOULDER (common in bench drilling)	Excessive rotation when retracting string	Adjust rotation speed
	Stuck rod in broken rock	Use Retrac bits and activate anti-jamming when drilling. Use a rock drill with power extractor



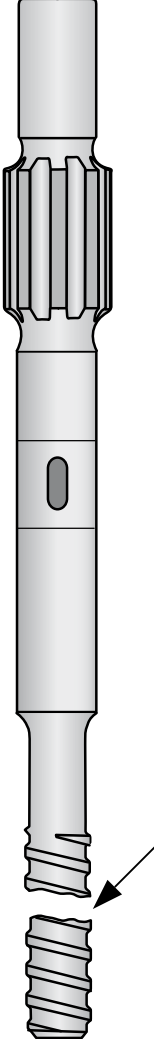
Error code C3

F:4 FAILURE AT FRONT HEAD	Misaligned boom	Ensure boom is aligned when drilling
	Misalignment from worn front bushing	Replace worn components
	Excessive feed	Reduce feed pressure, tune to rock conditions

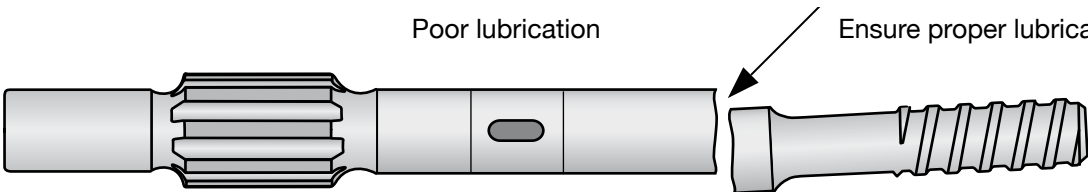


Error code Kxx/Nxx

F. SHANK ADAPTER FAILURES

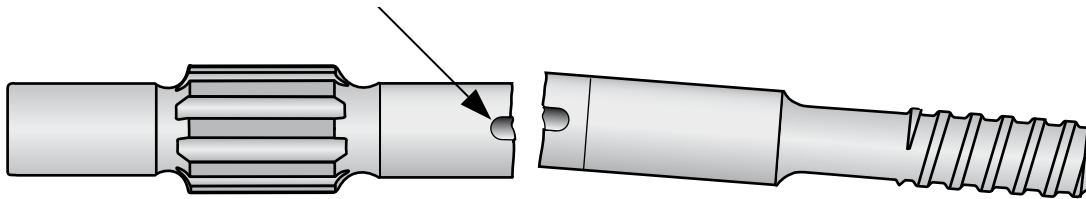
Failure mode	Probable cause	Recommended action
F:5 FAILURE IN THREADS  <p>Error code Kxx</p>	Drilling with open threads causing heat and pittings on thread	Adjust settings to balance impact, feed and rotation
	Poor drilling conditions	Adjust drilling pressures and tune to rock conditions. Use Retrac bit
	Misaligned boom	Ensure boom is aligned when drilling
	Mismatched threads	Use original Sandvik components
	Worn-out coupling	Replace worn-out couplings. Change out your couplings with new shank adapters. Use a bridged coupling sleeve
	Wandering or drifting hole	Employ guide tools and ballistic button bits
	Bending due to feed overpressure	Reduce feed pressure
	Bending due to misalignment	Utilise alignment instruments to monitor hole orientation once the hole has been collared. Replace wear pads on feed
	Heavy rotational torque caused by drilling with a worn bit giving high reflected energy	Regrind the bit when the wear flats are max. 1/3 of the button diameter
	Continued percussion with stuck rod in broken rock	Activate anti-jamming when drilling
Insufficient thread lubrication	Use thread grease	

F:6 FAILURE AT FRONT BUSHING

 <p>Error code Kxx</p>	Misalignment from worn front bushing	Replace worn components
	Poor lubrication	Ensure proper lubrication

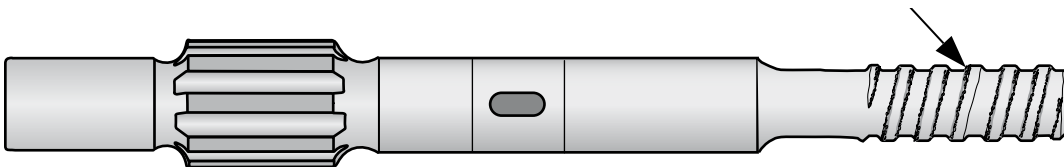
F. SHANK ADAPTER FAILURES

Failure mode	Probable cause	Recommended action
F:7 CORROSION	Corrosion from corrosive flushing agent	Replace broken/damaged components. Change or neutralize flushing agent
	Dirty flushing water	Clean water of solids. Use large water basins or install filters
	Fatigue	Replace more frequent



Error code Kxx

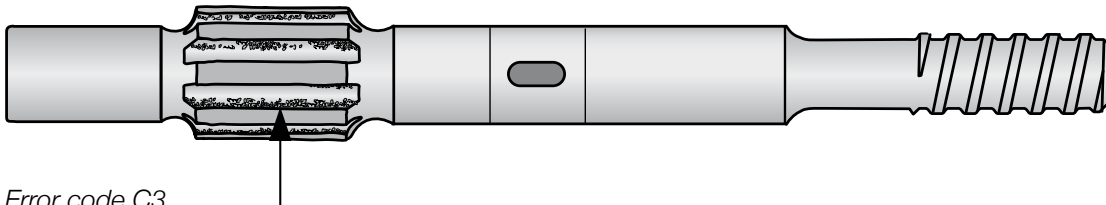
F:8 PITTING AND CHIPPING OF THREADS	Not balanced impact and feed pressures	Monitor coupling temperatures and adjust impact and feed pressures according to recommendations
	Loose joint	Use a Retrac bit with ballistic buttons to tighten string
	Incorrect relation between feed and rotation speed resulting in screaming during threading	Match feed and rotation speed according to specifications
	Insufficient thread lubrication	Use thread grease



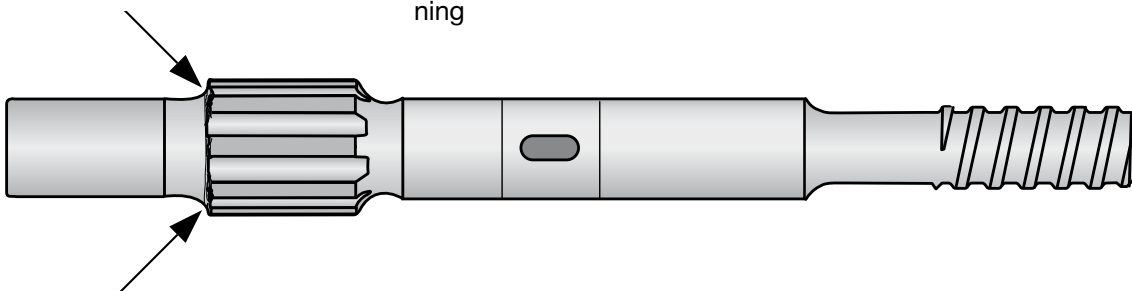
Error code A11

F. SHANK ADAPTER FAILURES

Failure mode	Probable cause	Recommended action
F:9 PITTING AND GALLING ON SPLINES	Poor or missing lubrication	Make sure that rock drill is receiving sufficient lubrication
	Excessive rotation in soft or broken ground	Adjust drilling pressures
	Incorrect shank lubrication oil	Change to recommended oil
	Hydraulic oil is too hot	Equip rig with a cooling unit
	Stuck rod in broken rock and/or excessive back hammering	Use Retrac bits and activate anti-jamming when drilling. Use a rock drill with power extractor

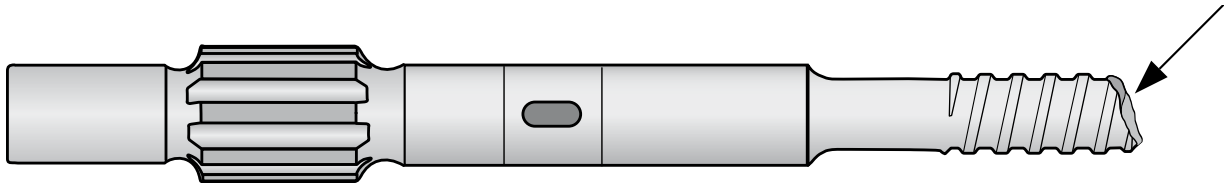


F:10 EXCESSIVE WEAR ON TOP OF SPLINE SHOULDER	Inadequate feed pressure	Adjust feed pressure according to recommendations
	Worn-out rotation bushing	Change bushing
	Damping piston is not functioning	Repair damping piston



F. SHANK ADAPTER FAILURES

Failure mode	Probable cause	Recommended action
F:11 CHIPPED THREAD END	Adapter dropped into coupling Machine cradle is too loose Misalignment of boom	Inspect feed for misalignment. Secure good alignment
	Adapter not properly coupled to drill steel.	Replace worn-out couplings. Use new couplings with new shank adapters
	Broken drill rod	Replace rod
	Drill steel end not square	Check alignment or hole deviation
	Corrosion	Replace components



Error code B4

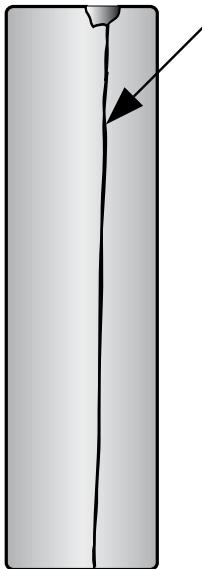
G. COUPLING SLEEVE FAILURES

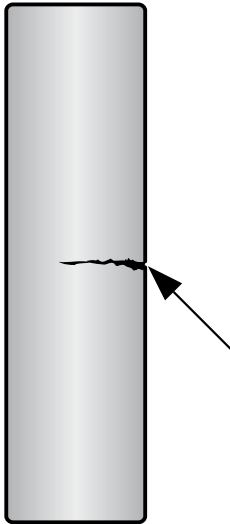
Failure mode	Probable cause	Recommended action
G:1 IMPACT MARKS, CHIPPED END	Starting percussion or rotation with the shank end resting against the shoulder of the coupling	Do not engage percussion or rotation if shank thread is not aligned inside coupling
	Misalignment of feed	Service affected equipment
	Misalignment due to hole deviation	Take action to drill straighter holes, eg. use a retrac bit, guide tube etc



Error code B4

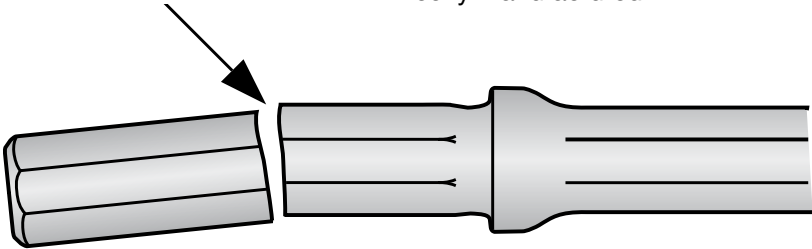
G. COUPLING SLEEVE FAILURES

Failure mode	Probable cause	Recommended action
G:2 LONGITUDINAL CRACK  <p>Error code B2</p>	<p>Drilling with loose thread joints</p> <p>Back rotation with percussion</p> <p>Nick or dent in steel surface</p> <p>Worn-out sleeve</p> <p>Hole deviation</p>	<p>Increase the feed force. Make sure that the joints are tightened before percussion. Avoid excessive back hammering</p> <p>Do not back rotate with percussion</p> <p>Avoid hammering on connection. Rotate loose or use a wrench to loosen joints. Employ proper care and handling</p> <p>Change sleeve</p> <p>Take action to drill straighter holes, eg. use a retrac bit, guide rod etc</p>

G:3 TRANSVERSAL CRACK  <p>Error code B1</p>	<p>Nick or dent in steel surface</p> <p>Worn-out sleeve</p> <p>Hole deviation or feed misalignment</p> <p>Inadequate feed pressure</p> <p>Heavy rotational loads from drilling with worn bits</p> <p>Mismatching threads</p>	<p>Avoid hammering on connection. Rotate loose or use a wrench to loosen joints. Employ proper care and handling</p> <p>Change sleeve</p> <p>Employ guide tools and ballistic button bits</p> <p>Monitor feed force and tune to conditions</p> <p>Regrind the bit when the wear flats are max. 1/3 of the button diameter</p> <p>Ensure all components are Sandvik manufactured. Do not "mix and match"</p>
--	--	---

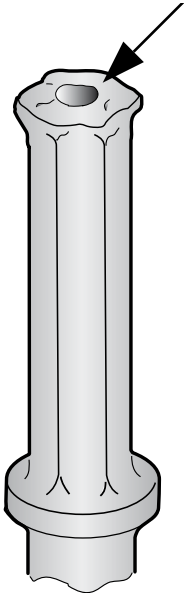
H. TAPERED ROD & INTEGRAL STEEL FAILURES

Failure mode	Probable cause	Recommended action
H:1 FAILURE IN THE SHANK END	Worn chuck bushing	Replace worn bushing
	Lack of or improper lubrication	Check that adequate volume of shank lubrication oil is reaching the shank
	Excessive feed pressure.	Reduced feed pressure
	Flushing hole in shank incorrectly manufactured	Return for analysis



Error code Nxx

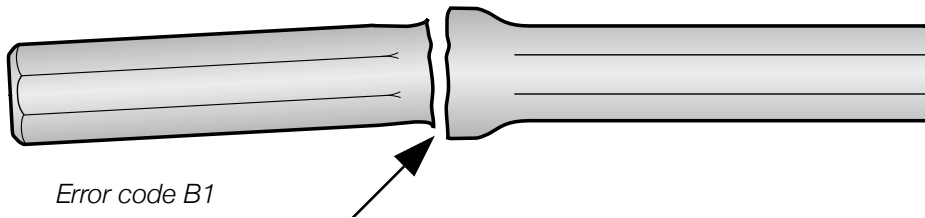
H:2 STRIKING FACE DEFORMED	Worn chuck bushing	Replace worn bushing
	Damaged piston	Replace piston
	High operating pressures	Adjust to rock conditions
	Hardness heat treatment not to specification	Return for analysis



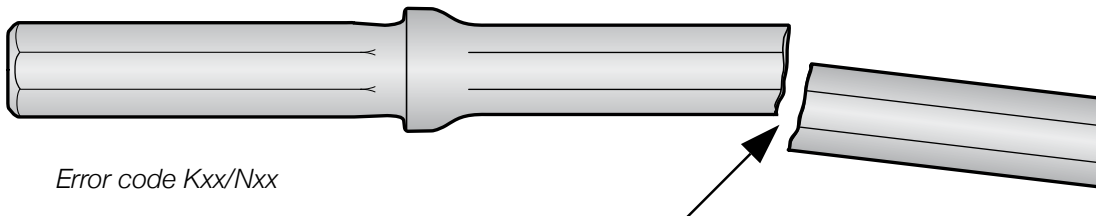
Error code C2

H. TAPERED ROD & INTEGRAL STEEL FAILURES

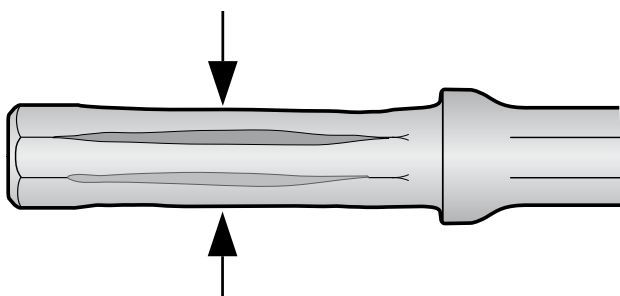
Failure mode	Probable cause	Recommended action
H:3 WEAR OR BREAKAGE AT BEGINNING OF COLLAR RADIUS	Indentation of the collar by chuck bushing. Worn chuck bushing	Replace worn bushing.
	Overheating due to poor lubrication	Ensure adequate lubrication is applied to shank
	Incorrect radius in transition between collar and shank	Return for analysis



H:4 BREAKAGE IN ROD SECTION	Drilling with bent rod	Keep rod aligned
	Surface damaged	Review handling routines
	Hit at corners	Do not hit rods when stuck in hole

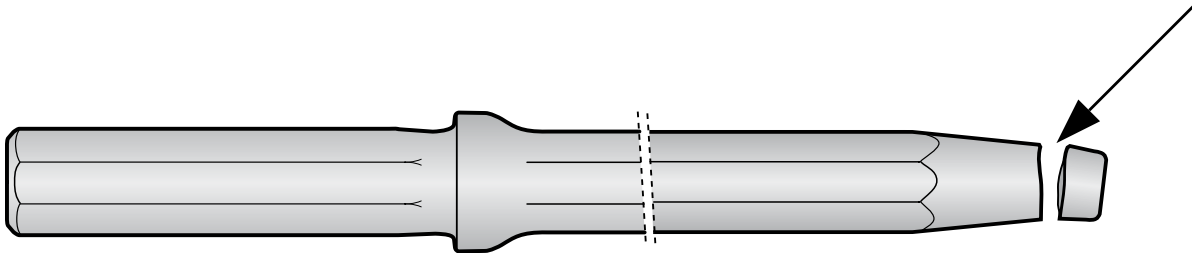


H:5 SHANK WEAR OR COKE BOTTLE WEAR	Worn chuck bushing	Replace worn bushing
---	--------------------	----------------------



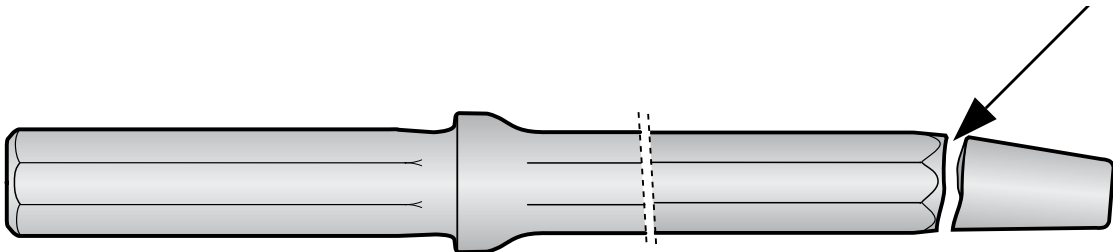
H. TAPERED ROD & INTEGRAL STEEL FAILURES

Failure mode	Probable cause	Recommended action
H:6 BREAKAGE ON TAPER RADIUS	Worn bit socket.	Change bit
	Using a damaged bit with a ridge or lip within the socket	Change bit or ream out ridge
	Spinning	Adjust feed force. Use Sandvik bits, do not "mix and match". Use bit with a symmetrical button design



Error code B1

H:7 BREAKAGE CLOSE TO BIT END	Drilling through the bottom of blocks	Improve working practices
	Excessive gauge wear on bit	Change to new bit earlier. Resharpen bit when wear flats are greater than 1/3 of button diameter
	Broken from flushing hole	Return for analysis



Error code Kxx

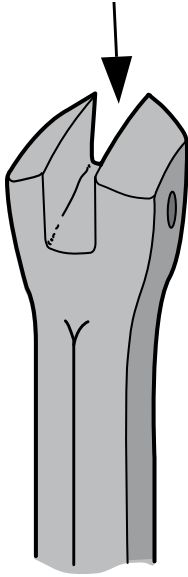
H. TAPERED ROD & INTEGRAL STEEL FAILURES

Failure mode	Probable cause	Recommended action
--------------	----------------	--------------------

H:8 FAILURE IN THE JOINT

Poor brazing

Return for analysis

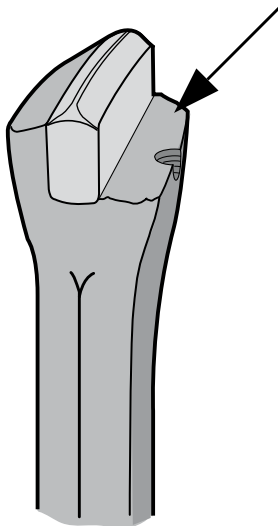


Error code L

H:9 FAILURE IN THE WING

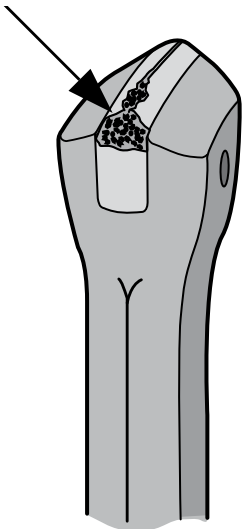
Quality issue

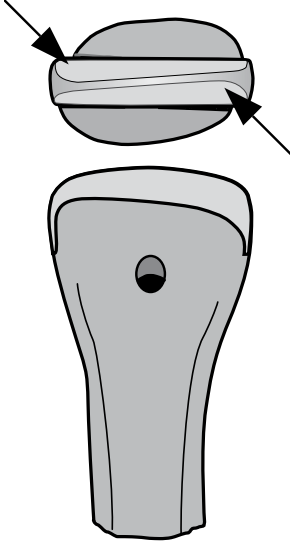
Return for analysis



Error code F

H. TAPERED ROD & INTEGRAL STEEL FAILURES

Failure mode	Probable cause	Recommended action
H:10 FAILURE IN THE CARBIDE 	Improper grinding - too sharp insert corners	Follow grinding instructions
	Overheating insert when resharpening	Resharpen insert to its original shape. Follow proper grinding procedures and use correct grinding wheel
	Drilling conditions creating snakeskin	Lower rotation and reduce hammer pressure. Early regrinding even if no wear flats
	Antitaper	Employ proper grinding routines
<i>Error code S</i>		

H:11 PROPELLER WEAR 	Poor flushing	Increase flushing pressure
	Poor rotation	Increase rotation speed

NOTES:
