

TOP HAMMER TOOLS **FAILURE ANALYSIS GUIDE**



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FAILURE ANALYSIS GUIDE

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ROCK DRILLING TOOLS FAILURE ANALYSIS GUIDE

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**

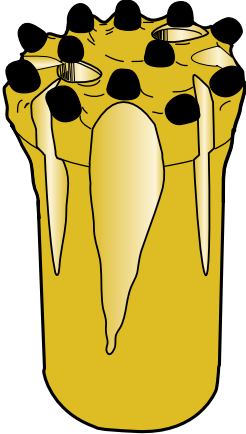
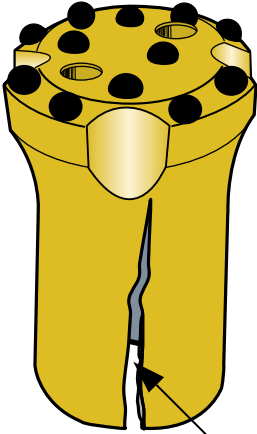
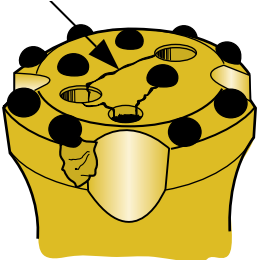
Hole misalignment through poorly serviced rigs, bad collaring and wandering holes are the foremost factors contributing to stress in the drill string and subsequent tool failure. It is imperative that all reasonable measures are taken to drill straight holes.

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.

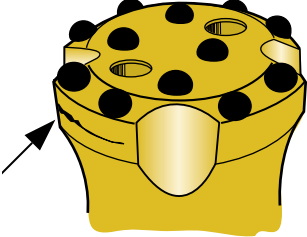
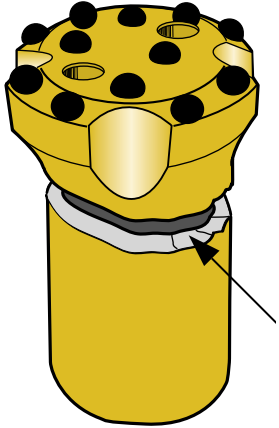
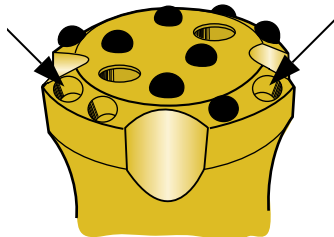
It is important to check grinding practices to ensure that they are carried out in a competent manner. On many occasions it has been observed that dry grinding wheels have been used for wet grinding which will almost certainly lead to carbide failure. In non-wearing rock formations 'snakeskin' fatigue 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 a Sandvik representative.

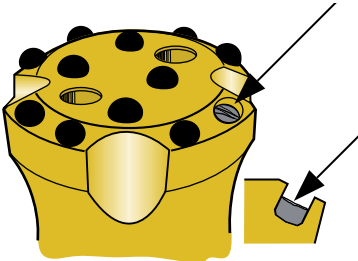
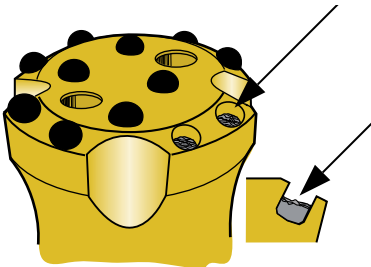
A. BUTTON BIT FAILURES

Failure mode	Probable cause	Recommended action
A:1 BODY WASH 	Excessive flushing volume Drilling with excessive flushing volume can in some rock cause sand-blasting of the steel and too big protrusion and breakage of the buttons	Reduce flushing volume Shorten grinding intervals Photograph »
A:2 SPLIT SKIRT  Error code B2	Drilling with the thread open Wrong procedure when loosening the bit Drilling with too worn threads	Increase feed force. Tighten joints before percussion. 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. Change to new rods. Make sure specified rods are used. Photograph »
A:3 STEEL CRACK BETWEEN BUTTON-OR FLUSHING HOLES  Error code F1f	Final failure when drilling a bit with big buttons (Heavy Duty) in non wearing rock like limestone Manufacturing error. Inferior button hole-drilling precision	Change to bit with other design. Return for analysis. Photograph »

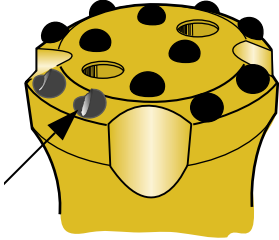
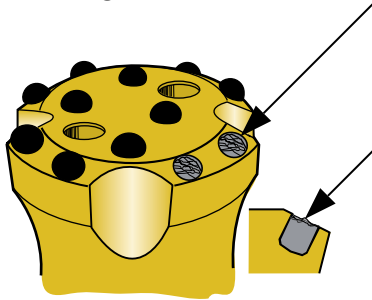
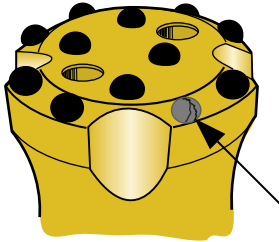
A. BUTTON BIT FAILURES

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

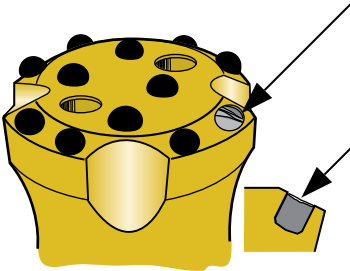
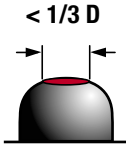
A. BUTTON BIT FAILURES

Failure mode	Probable cause	Recommended action
A:7 SNAKESKIN OR MICRO-CRACKS IN CEMENTED CARBIDE  Error code S9	Drilling in non-abrasive rock creates micro-fractures in the carbide sometimes looking like snake skin. The rock leaves a shiny surface on the buttons and a fatigue in the surface of the cemented carbide, leading to button failure.	Earlier regrinding even if there are no or small wear flats Use a softer carbide grade. <i>Photograph »</i>
A:8 BUTTONS SHEARED-OFF UNDER BODY LEVEL  Error code S7u	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. Incorrect size correlation between button and button hole	Shorten grinding intervals. Return for analysis. <i>Photograph »</i>
A:9 BUTTONS CRUSHED INSIDE THE BIT BODY  Error code S4u	Bad collaring practices Anti-taper from abrasive rock 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.	Ensure the boom is secure. Start collaring with reduced impact, then full pressure once bit is embedded 300 mm in the rock. Grind bit to original shape. Ensure correct grinding procedures. <i>Photograph »</i>

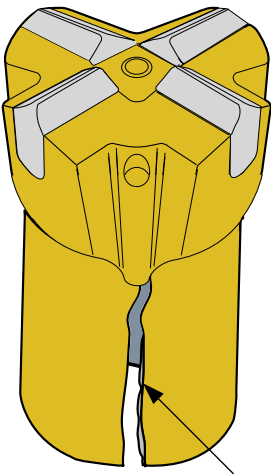
A. BUTTON BIT FAILURES

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

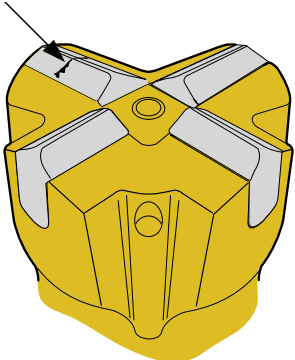
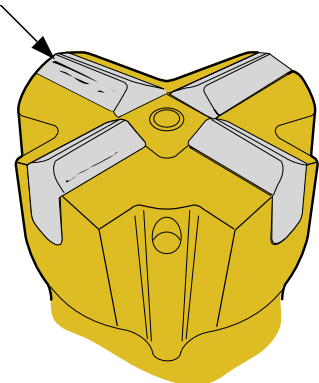
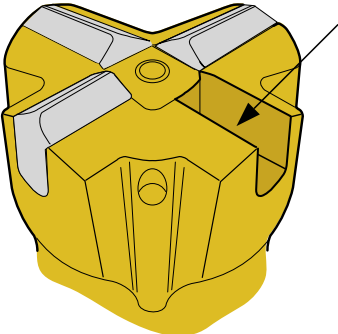
A. BUTTON BIT FAILURES

Failure mode	Probable cause	Recommended action
A:13 TOP OF BUTTON SHEARED OFF LEVEL WITH BODY  <i>Error code S7</i>	Overdrilling Drilling into metal Snakeskin 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. Regrind when the wear flats are max 1/3 of the button diameter.  Ensure correct drilling practices. Regularly inspect the bits and grind to remove micro-cracks from the surface of the cemented carbide. Shorten grinding intervals. <i>Photograph »</i>

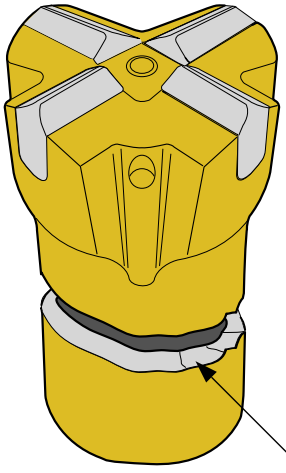
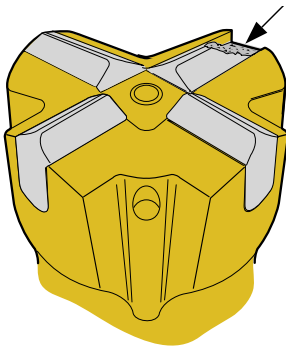
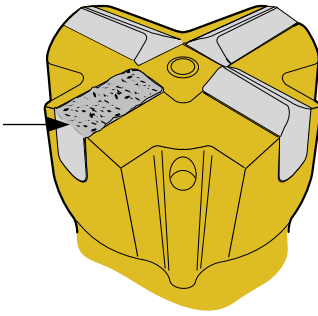
B. CROSS BIT FAILURES

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

B. CROSS BIT FAILURES

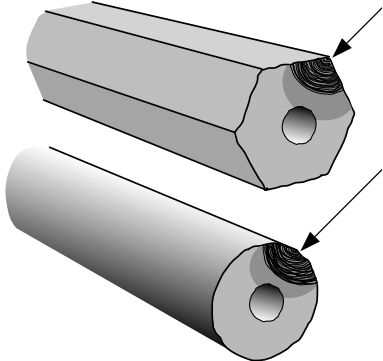
Failure mode	Probable cause	Recommended action
B:2 TRANSVERSAL CRACK  <i>Error code S1</i>	Overheating from improper grinding Anti-taper from abrasive rock Grinding scratches due to wrong grinding wheel	Regrind bit to its original shape. Follow proper bit grinding procedures. Shorten grinding intervals.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

B. CROSS BIT FAILURES

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

Photograph »

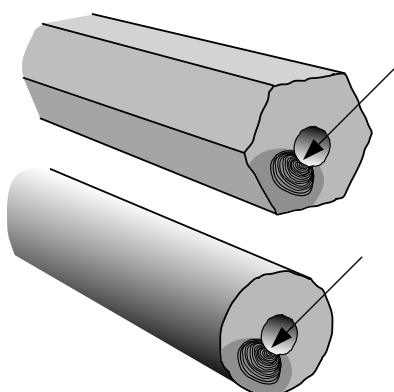
C. EXTENSION ROD FAILURES

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

Photograph »

C. EXTENSION ROD FAILURES

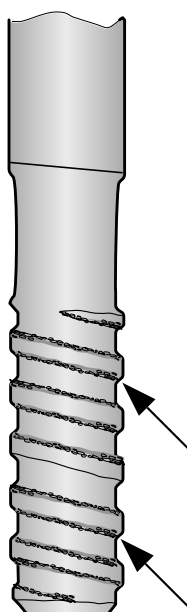
Failure mode	Probable cause	Recommended action
C:2 ROD BREAKAGE CHARACTERISED BY A FATIGUE ROSE ORIGINATING FROM THE FLUSHING HOLE	Corrosion caused by corrosive flushing agents	Ensure that proper storage practices are being followed. Change components more frequently or neutralise flushing agent.
	Insufficient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



Error code Kxxi/Nxxi

Photograph »

C:3 PITTING OR WEAR IN THE THREADS	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 all rods together.



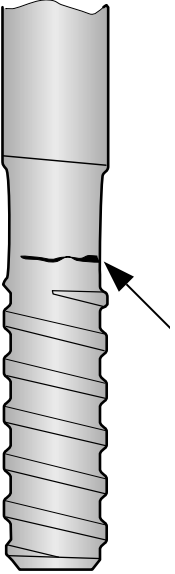
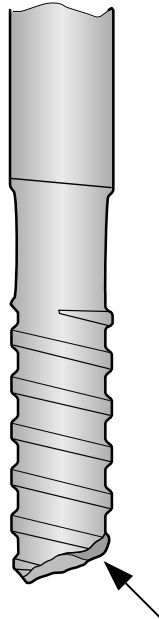
Error code A11

Drilling with worn bits

Regrind the bit when the wear flats are max. 1/3 of the button diameter.

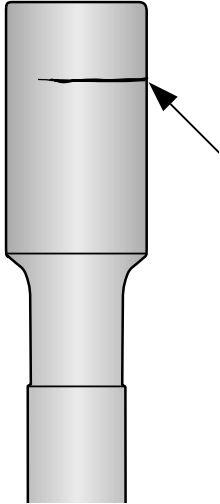
Photograph »

C. EXTENSION ROD FAILURES

Failure mode	Probable cause	Recommended action
C:4 FAILURE AT THE BEGINNING OF THE THREAD OR WHERE THE COUPLING ENDS  Error code Kxx	Wandering or drifting hole Worn threads and/or coupling. M/M rods: migrating coupling (bridge worn out) Bending due to feed overpressure Bending due to misalignment Heavy rotational loads caused by drilling with a worn bit giving high reflected energy Poor drilling conditions Continued percussion with stuck rod	Employ guide tools and ballistic button bits. Replace worn components. Do not put a worn coupling on a new rod. Change couplings and rods together. Reduce feed pressure. Utilise alignment instruments to monitor hole orientation once the hole has been collared. Replace wear pads on feed. Regrind the bit when the wear flats are max. 1/3 of the button diameter. Adjust drilling pressures and tune to rock conditions. Use Retractable bit. Activate anti-jamming when drilling.
C:5 CHIP BROKEN OFF MALE THREAD  Error code B4	Inadequate feed pressure Worn coupling Misalignment of rods with extension. Steel hitting coupling shoulder Drilling with worn bits Corrosion fatigue due to corrosive flushing water	Adjust pressure to conditions. Replace worn components. Do not put a worn coupling on a new rod. Align drilling components with extension. Maintain button bits in time. Replace rod. Treat water.

Photograph »

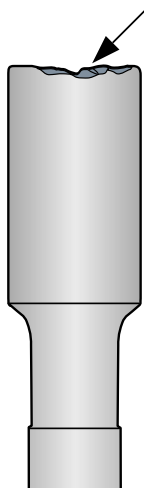
C. EXTENSION ROD FAILURES

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

Error code B1

Photograph »

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



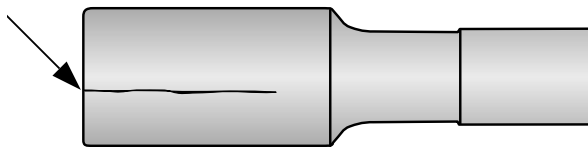
Error code B4

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

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.

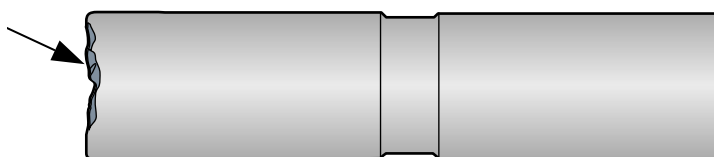


Error code B2

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D. GUIDE TUBE FAILURES

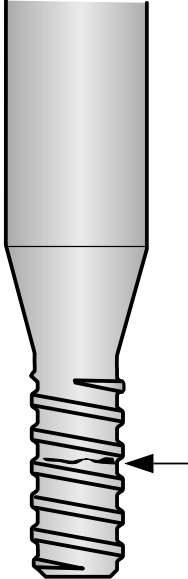
Failure mode	Probable cause	Recommended action
D:1 FEMALE END IS CHIPPED, CRACKED AND/OR FLARED	Thread joint not firmly tightened	Make sure threads are tight before engaging percussion.
	Misalignment of feed	Service affected equipment.
	Starting percussion or rotation with end of the shank resting against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



Error code B4

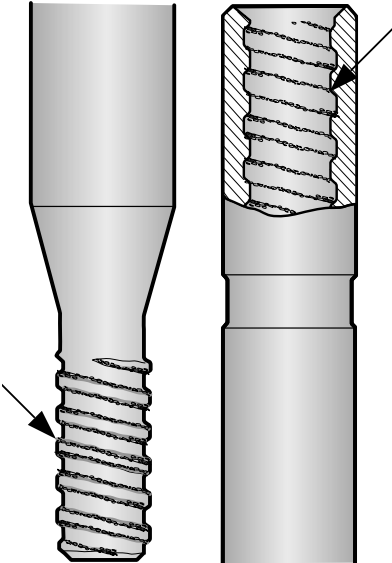
Photograph »

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

Photograph »

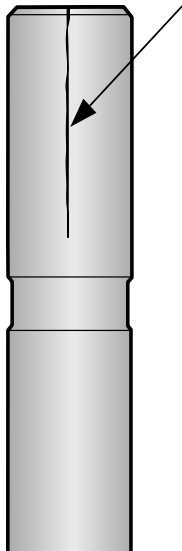
D:3 PITTING OR WEAR IN THE THREADS 	Reflected percussive energy	Adjust feed and percussion pressures to the rock conditions.
	Free hammering	Do not engage full percussion unless the bit is firmly seated against rock. Use reduced percussion when collaring on uneven surfaces.
	Worn threads	Replace worn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

Error code A11

Photograph »

D. GUIDE TUBE FAILURES

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



Error code B2

Photograph »

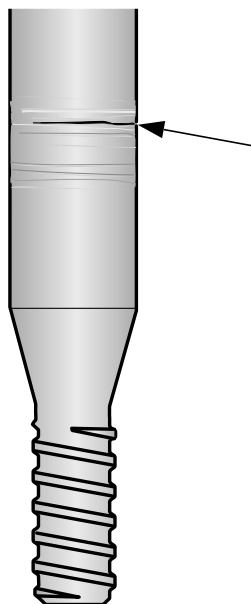
D:5 BREAK IN TUBE BODY

Surface damage caused by worn out centralisers

Replace centralisers.

Nick or dent in steel surface

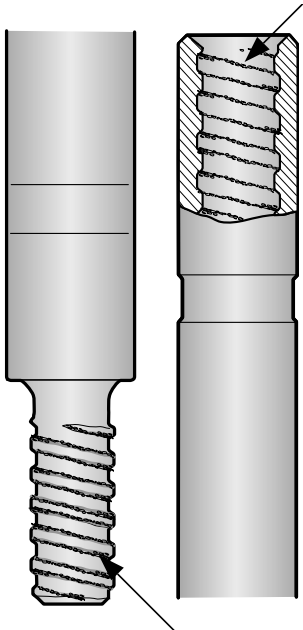
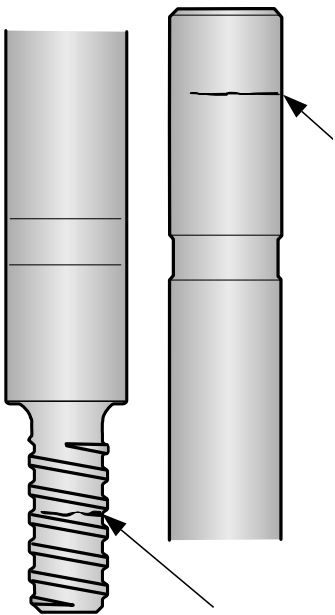
Avoid hammering on the tube.
Employ proper care and handling.



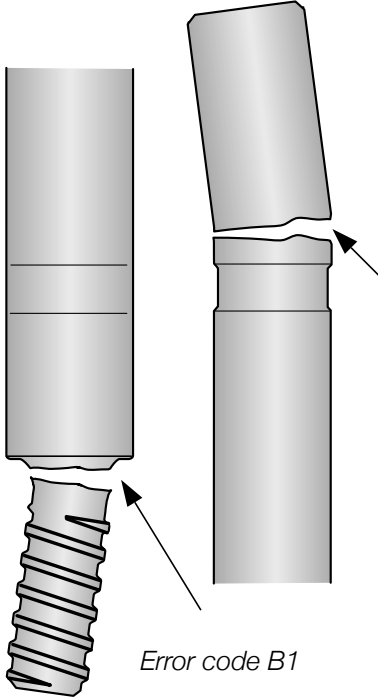
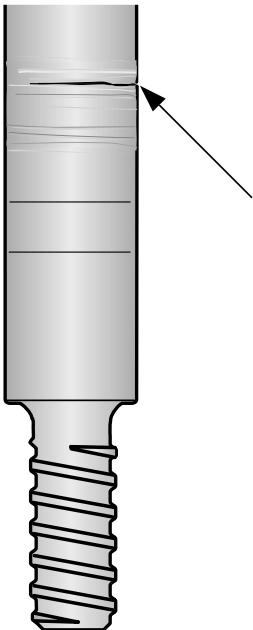
Error code Kxx/Nxx/B1

Photograph »

E. TUBE FAILURES

Failure mode	Probable cause	Recommended action
E:1 PITTING OR WEAR ON THREADS  Error code A11	Inadequate feed pressure and/or high percussion Cuttings in thread Corrosion caused by corrosive flushing agents	Adjust machine settings. Keep flushing on when breaking pipe. Change components more frequently or neutralise flushing agent. Photograph »
E:2 FAILURE IN MALE OR FEMALE THREAD SECTION  Error code Kxx/Nxx	Misalignment of feed Hole deviation Hit on thread Corrosion caused by corrosive flushing agents	Make sure boom is aligned. Ensure good collaring practices. Employ Retrac bits with ballistic buttons. Ensure good rod handling practices. Change components more frequently or neutralise flushing agent. Photograph »

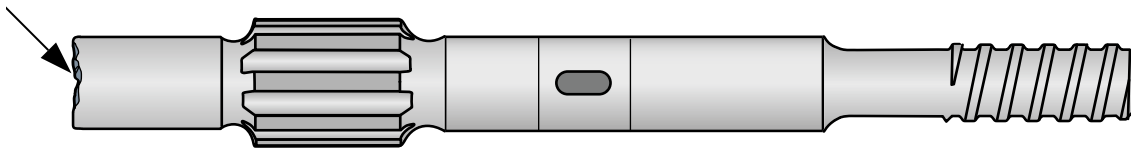
E. TUBE FAILURES

Failure mode	Probable cause	Recommended action
E:3 BREAK IN THREAD CLEARANCE  Error code B1	Corrosion caused by corrosive flushing agents Misalignment of tube during friction welding	Change components more frequently or neutralise flushing agent. Return for analysis.
E:4 BREAK IN TUBE  Error code B1	Friction martensite from worn out centraliser jaws Misalignment of feed Hole deviation Nick on tube	Change centraliser jaws. Make sure boom is aligned. Ensure good collaring practices. Employ Retractable bits with ballistic buttons. Ensure good rod handling practices.

Photograph »

F. SHANK ADAPTER FAILURES

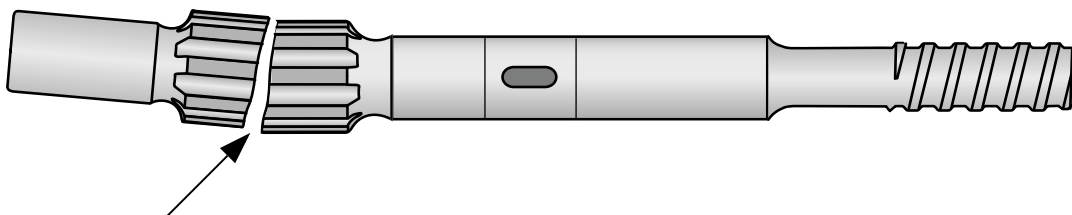
Failure mode	Probable cause	Recommended action
F:1 IMPACT MARKS, CHIPPED OR RIVETED END	Misalignment due to worn out bushings Damaged piston	Replace worn components in rock drill. Replace piston. Service affected equipment. Service rock drill.



Error code C2

Photograph »

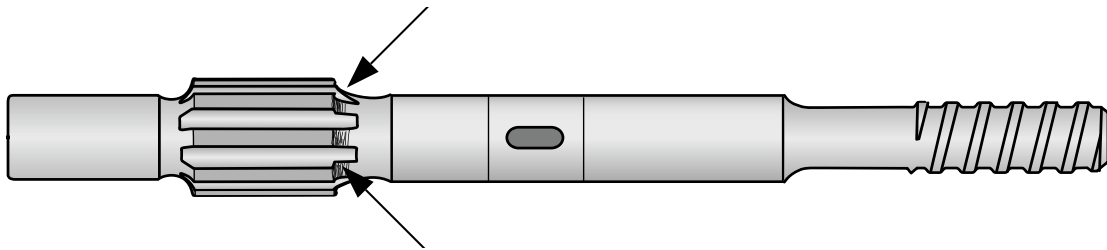
F:2 FAILURE ACROSS SPLINES	Poor or no lubrication	Ensure functioning lubrication
	Wrong or contaminated shank lubrication oil	Change to correct oil.
	Stuck rod in broken rock and/or excessive back hammering	Use Retrac bits and activate anti-jammig when drilling.
	Worn out chuck coupling	Replace worn 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

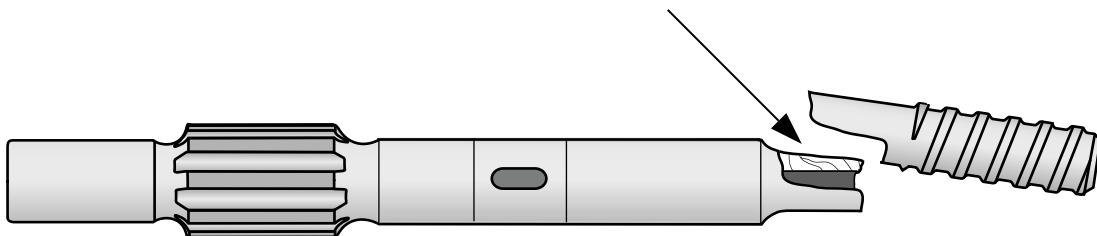
Failure mode	Probable cause	Recommended action
F:3 WEAR ON BOTTOM OF SPLINE SHOULDER (common in bench drilling)	Excessive rotation when retracting string	Adjust rotation speed.
	Stuck rod in broken rock	Use Retrac bits and activate anti-jamming when drilling. Use a rock drill with power extractor.



Error code C3

Photograph »

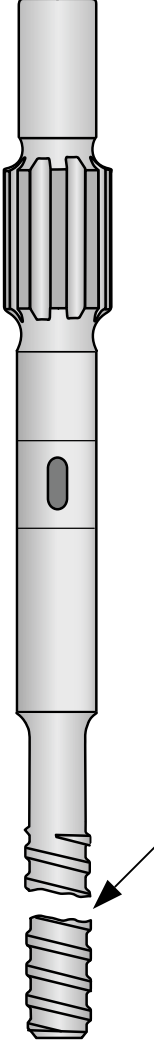
F:4 FAILURE AT FRONT HEAD	Misaligned boom	Ensure boom is aligned when drilling.
	Misalignment from worn front bushing	Replace worn components.
	Excessive feed	Reduce feed pressure, tune to rock conditions.



Error code Kxx/Nxx

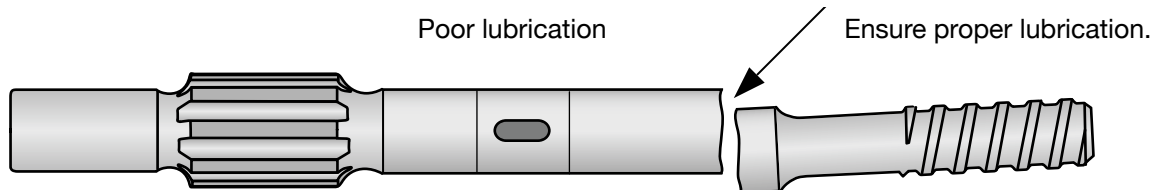
Photograph »

F. SHANK ADAPTER FAILURES

Failure mode	Probable cause	Recommended action
F:5 FAILURE IN THREADS  Error code Kxx	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 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.

Photograph »

F:6 FAILURE AT FRONT BUSHING

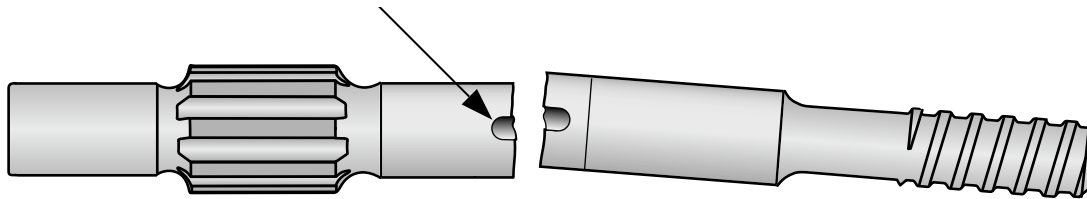


Error code Kxx

Photograph »

F. SHANK ADAPTER FAILURES

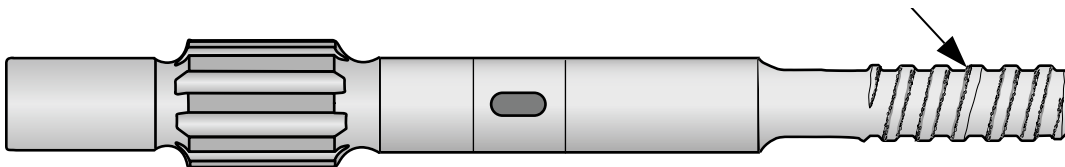
Failure mode	Probable cause	Recommended action
F:7 CORROSION	Corrosion from corrosive flushing agent	Replace broken/damaged components. Change or neutralize flushing agent.
	Dirty flushing water	Clean water of solids. Use large water basins or install filters.
	Fatigue	Replace more frequent



Error code Kxx

Photograph »

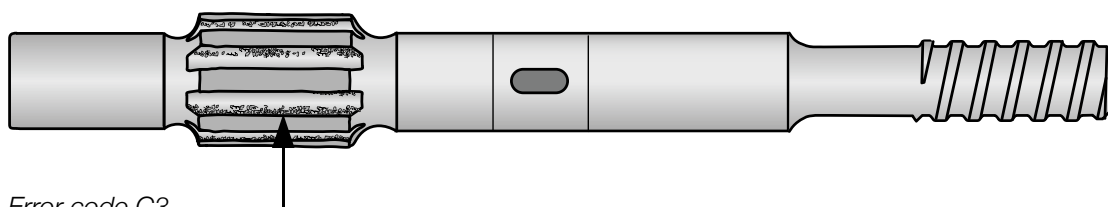
F:8 PITTING AND CHIPPING OF THREADS	Not balanced impact and feed pressures	Monitor coupling temperatures and adjust impact and feed pressures according to recommendations.
	Loose joint	Use a Retrac bit with semi-ballistic buttons to tighten string.
	Incorrect relation between feed and rotation speed 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

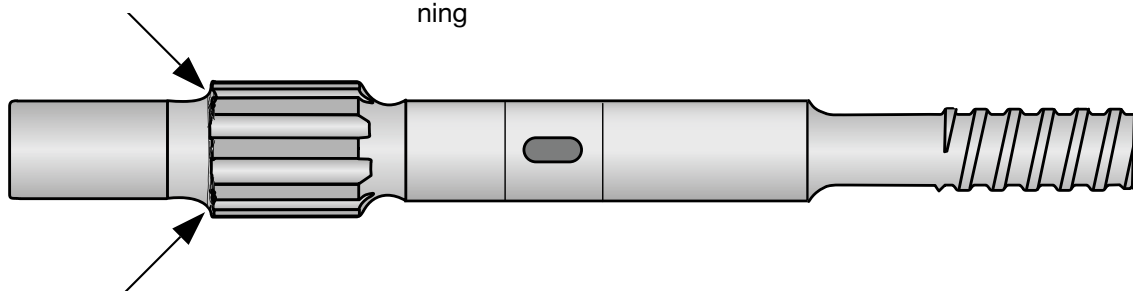
Failure mode	Probable cause	Recommended action
F:9 PITTING AND GALLING ON SPLINES	Poor or missing lubrication	Make sure that rock drill is receiving sufficient lubrication
	Excessive rotation in soft or broken ground	Adjust drilling pressures.
	Incorrect shank lubrication oil	Change to recommended oil.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



Error code C3

Photograph »

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.

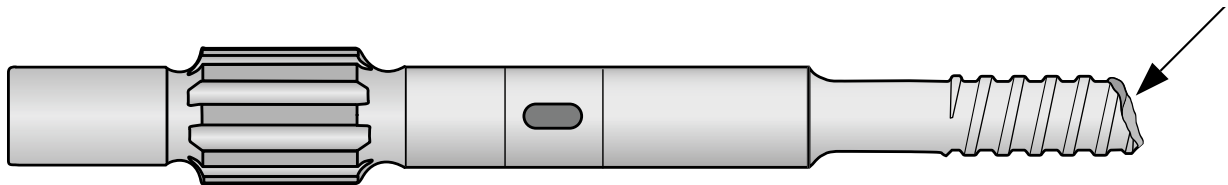


Error code C3

Photograph »

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.



Error code B4

Photograph »

G. COUPLING SLEEVE FAILURES

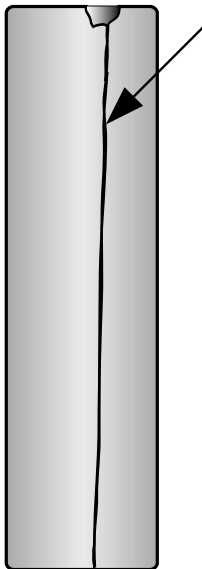
Failure mode	Probable cause	Recommended action
G:1 IMPACT MARKS, CHIPPED END	Starting percussion or rotation with the shank end resting against the shoulder of the coupling	Do not engage percussion or rotation if shank thread is not aligned inside coupling.
	Misalignment of feed	Service affected equipment.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



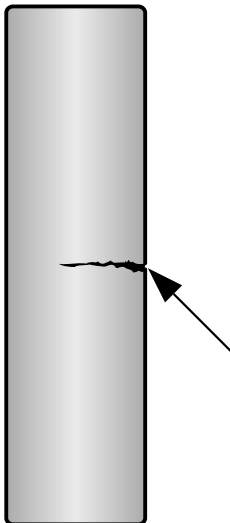
Error code B4

Photograph »

G. COUPLING SLEEVE FAILURES

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

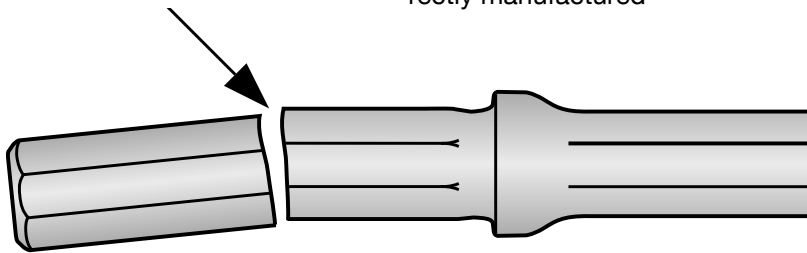
Error code B2

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

Error code B1

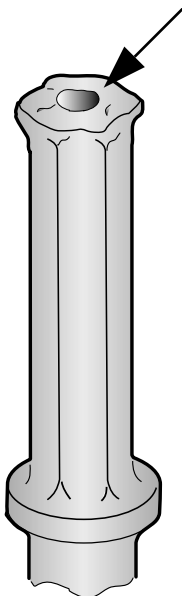
H. TAPERED ROD & INTEGRAL FAILURES

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.

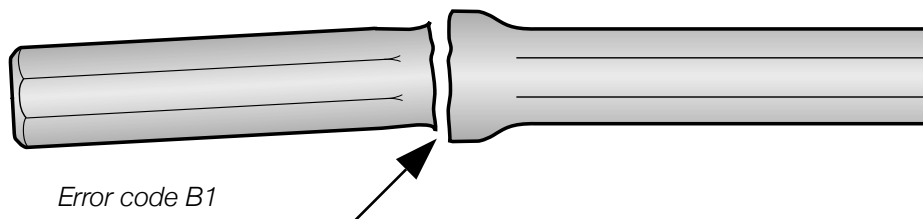


Error code C2

Photograph »

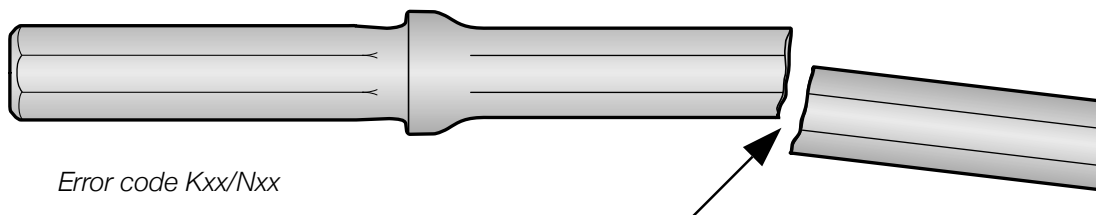
H. TAPERED ROD & INTEGRAL FAILURES

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

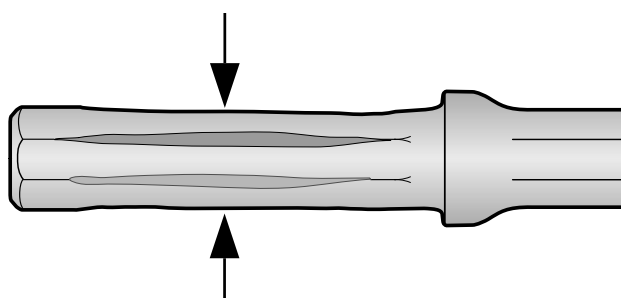


Photograph »

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.

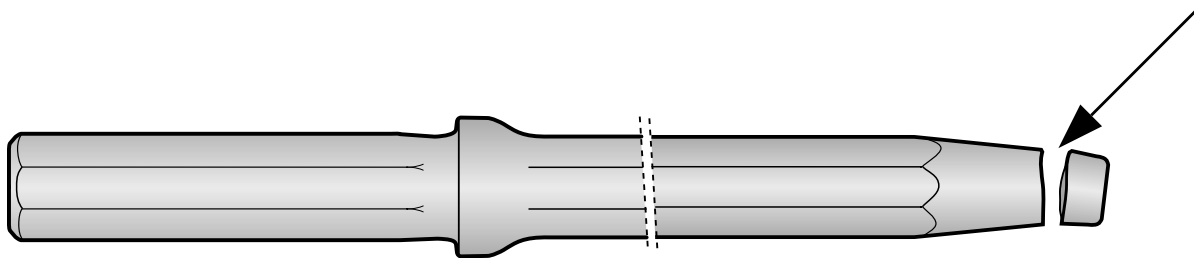


H:5 SHANK WEAR OR COKE BOTTLE WEAR	Worn chuck bushing	Replace worn bushing.
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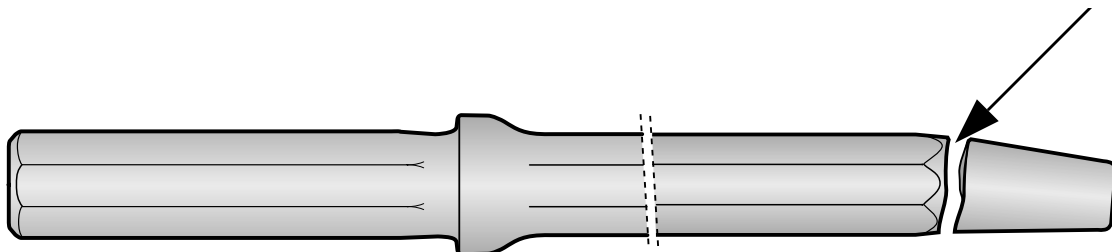
H. TAPERED ROD & INTEGRAL FAILURES

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 gauge	Reduce service life. Resharpen bit when wear flats are greater than 1/3 of button diameter
	Broken from flushing hole	Return for analysis.



Error code Kxx

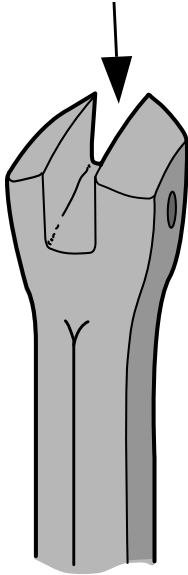
H. TAPERED ROD & INTEGRAL FAILURES

Failure mode	Probable cause	Recommended action
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H:8 FAILURE IN THE JOINT

Poor brazing

Return for analysis.



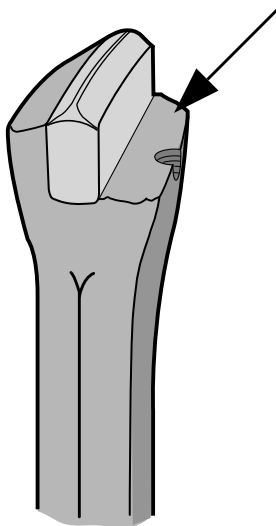
Error code L

Photograph »

H:9 FAILURE IN THE WING

Quality issue

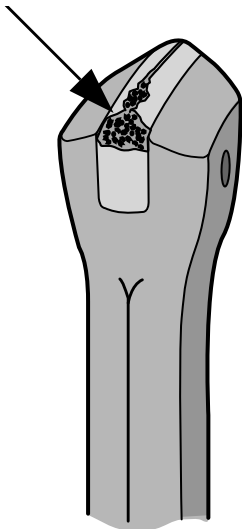
Return for analysis.



Error code F

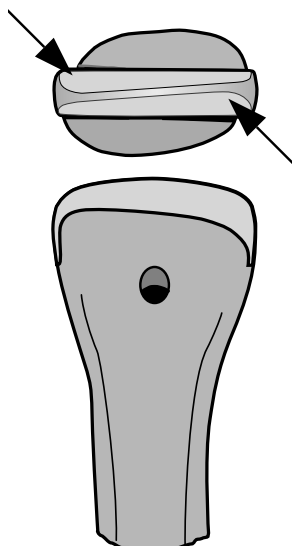
Photograph »

H. TAPERED ROD & INTEGRAL FAILURES

Failure mode	Probable cause	Recommended action
H:10 FAILURE IN THE CARBIDE  Error code S	Improper grinding - too sharp insert corners Overheating insert when resharp- pening. Drilling conditions creating sna- keskin Antitaper	Follow grinding instructions Resharpen insert to its original shape. Follow proper grinding procedures and use correct grind- ing wheel. Lower rotation and reduce ham- mer pressure. Early regrinding even if no wear flats. Employ proper grinding routines

Photograph »

H:11 PROPELLER WEAR



Poor flushing

Poor rotation

Increase flushing pressure.

Increase rotation speed.

Photograph »

FAILURE ANALYSIS GUIDE

PHOTO APPENDIX



A. BUTTON BIT FAILURES

A:1 BODY WASH



A. BUTTON BIT FAILURES

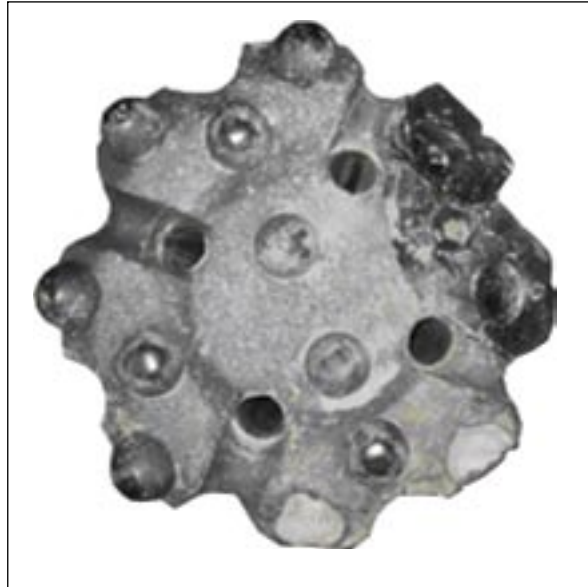
A:2 SPLIT SKIRT



Error code B2

A. BUTTON BIT FAILURES

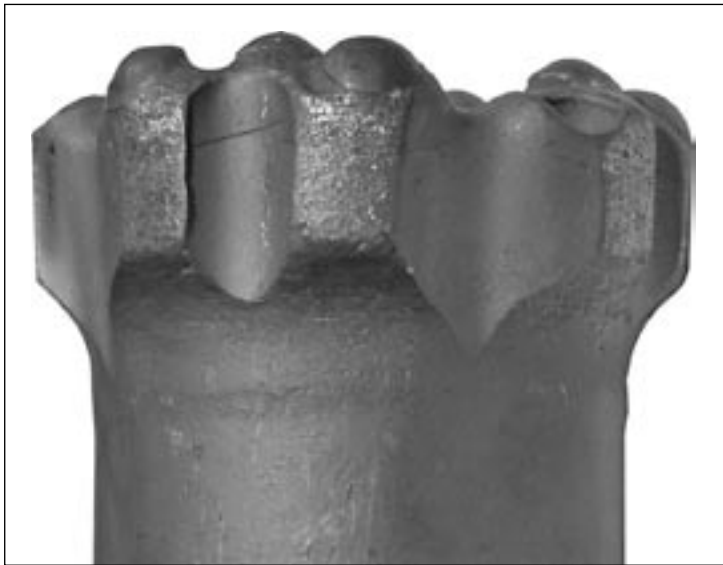
A:3 STEEL CRACK BETWEEN BUTTON- OR FLUSHING HOLES



Error code F1f

A. BUTTON BIT FAILURES

A:4 STEEL CRACK IN THE BIT BODY ORIGINATING FROM THE BOTTOM OF A BUTTON HOLE



Error code F1b

A. BUTTON BIT FAILURES

A:5 SKIRT RING-OFF



Error code B1



A. BUTTON BIT FAILURES

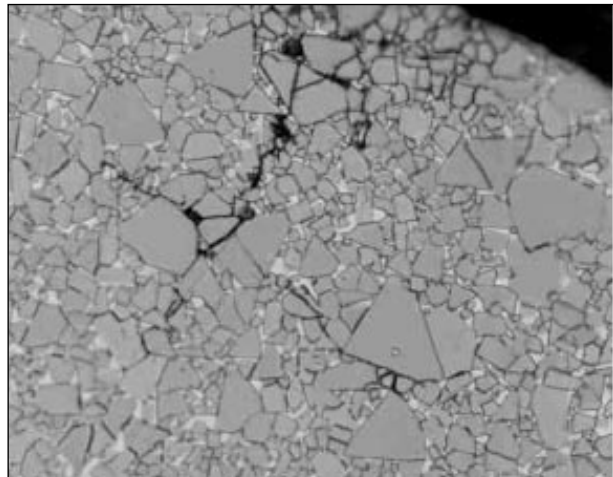
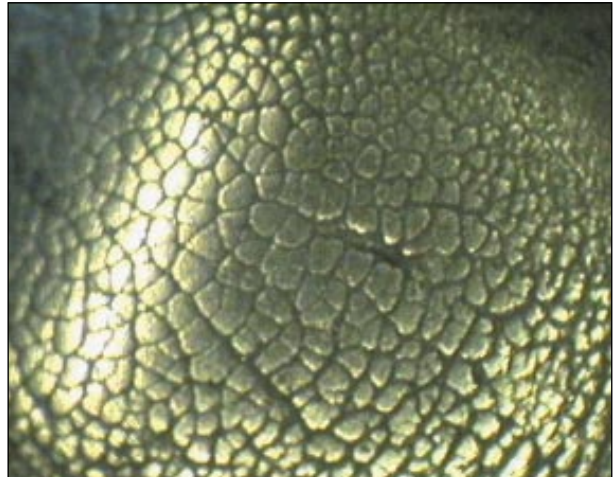
A:6 LOST BUTTONS



Error code L1

A. BUTTON BIT FAILURES

A:7 SNAKESKIN OR MICRO-CRACKS IN CEMENTED CARBIDE



Error code S9

A. BUTTON BIT FAILURES

A:8 BUTTONS SHEARED-OFF UNDER BODY LEVEL



Error code S7u

A. BUTTON BIT FAILURES

A:9 BUTTONS CRUSHED INSIDE THE BIT BODY



Error code S4u

A. BUTTON BIT FAILURES

A:10 BUTTON CHIPPED



Error code S3



A. BUTTON BIT FAILURES

A:11 BUTTON CRUSHED DOWN TO LEVEL OF BIT BODY



Error code S4

A. BUTTON BIT FAILURES

A:12 BUTTON CRACKED



Error code S1

A. BUTTON BIT FAILURES

A:13 TOP OF BUTTON SHEARED OFF LEVEL WITH BODY



Error code S7

B. CROSS BIT FAILURES

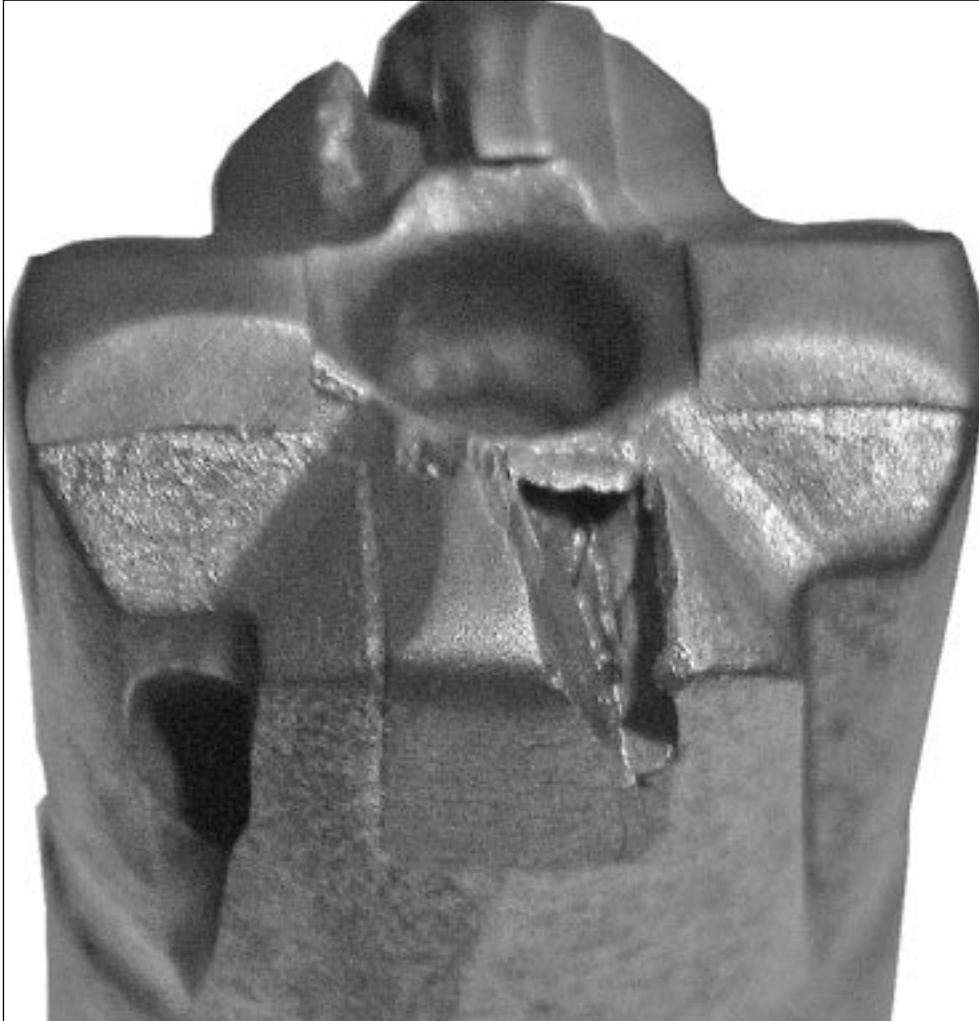
B:2 TRANSVERSAL CRACK



Error code S1

B. CROSS BIT FAILURES

B:3 LONGITUDINAL CRACKS



Error code S5

B. CROSS BIT FAILURES

B:4 WHOLE INSERT LOST



Error code L1

B. CROSS BIT FAILURES

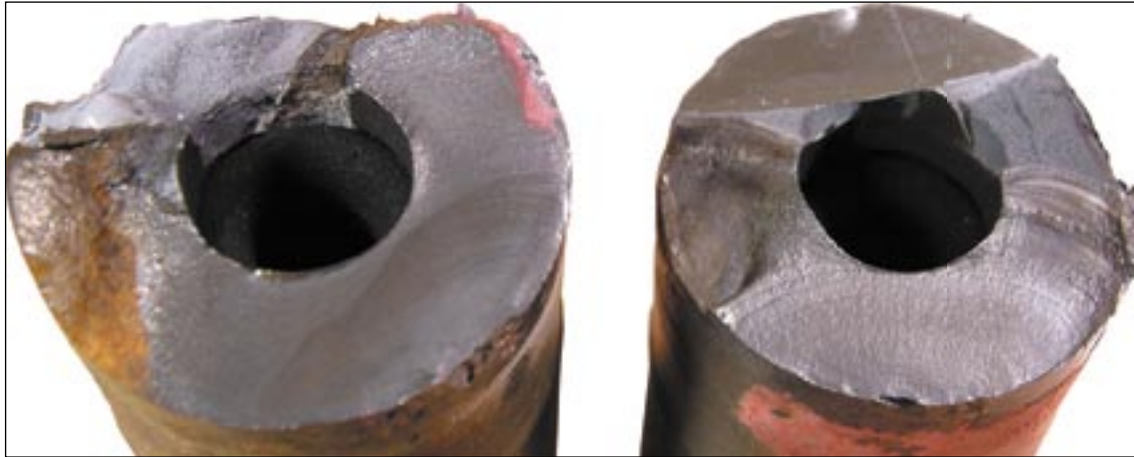
B:6 INSERT CORNER FRACTURED



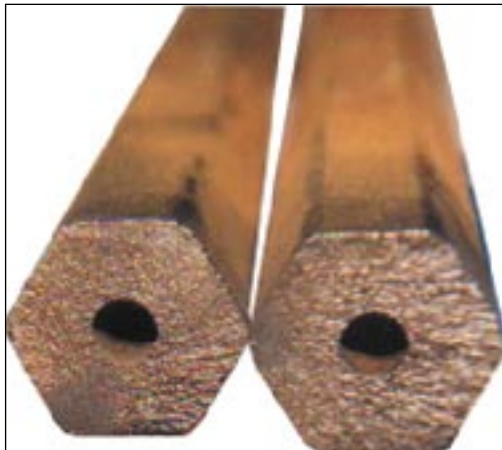
Error code L2

C. EXTENSION ROD FAILURES

C:1 SURFACE LAYER OF STEEL COMPROMISED BY A NICK OR DENT, FATIGUE ROSE ORIGINATING FROM THE SURFACE

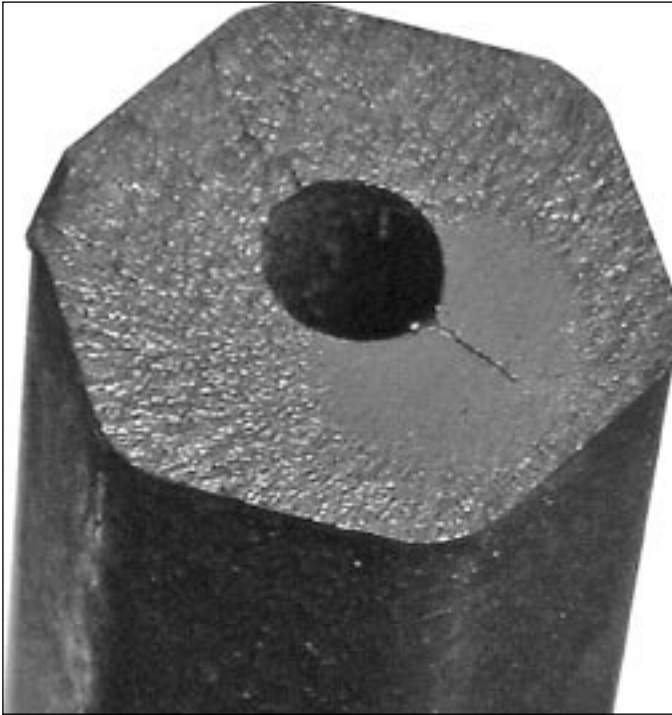


Error code Kxxu/Nxxu



C. EXTENSION ROD FAILURES

C:2 ROD BREAKAGE CHARACTERISED BY A FATIGUE ROSE ORIGINATING FROM THE FLUSHING HOLE



Error code Kxxl/Nxxl

C. EXTENSION ROD FAILURES

C:3 PITTING OR WEAR IN HE THREADS



Error code A11

C. EXTENSION ROD FAILURES

C:5 CHIP BROKEN OFF MALE THREAD



Error code B4

C. EXTENSION ROD FAILURES

C:6 FAILURE ACROSS FEMALE THREAD SECTION



Error code B1

C. EXTENSION ROD FAILURES

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



Error code B4

[« Back](#)

C. EXTENSION ROD FAILURES

C:8 LONGITUDINAL CRACK IN FEMALE CONNECTION



Error code B2

D. GUIDE TUBE FAILURES

D:1 FEMALE END IS CHIPPED, CRACKED AND/OR FLARED



Error code B4

D. GUIDE TUBE FAILURES

D:2 FAILURE ACROSS MALE THREAD SECTION



Error code Kxx

D. GUIDE TUBE FAILURES

D:3 PITTING OR WEAR IN THE THREADS



Error code A11

D. GUIDE TUBE FAILURES

D:4 LONGITUDINAL CRACK IN FEMALE CONNECTION



Error code B2

D. GUIDE TUBE FAILURES

D:5 BREAK IN TUBE BODY



Error code Kxx/Nxx/B1



E. TUBE FAILURES

E:1 PITTING OR WEAR ON THREADS



Error code A11

E. TUBE FAILURES

E:2 FAILURE IN MALE OR FEMALE THREAD SECTION



Error code Kxx/Nxx

E. TUBE FAILURES

E:4 BREAK IN TUBE

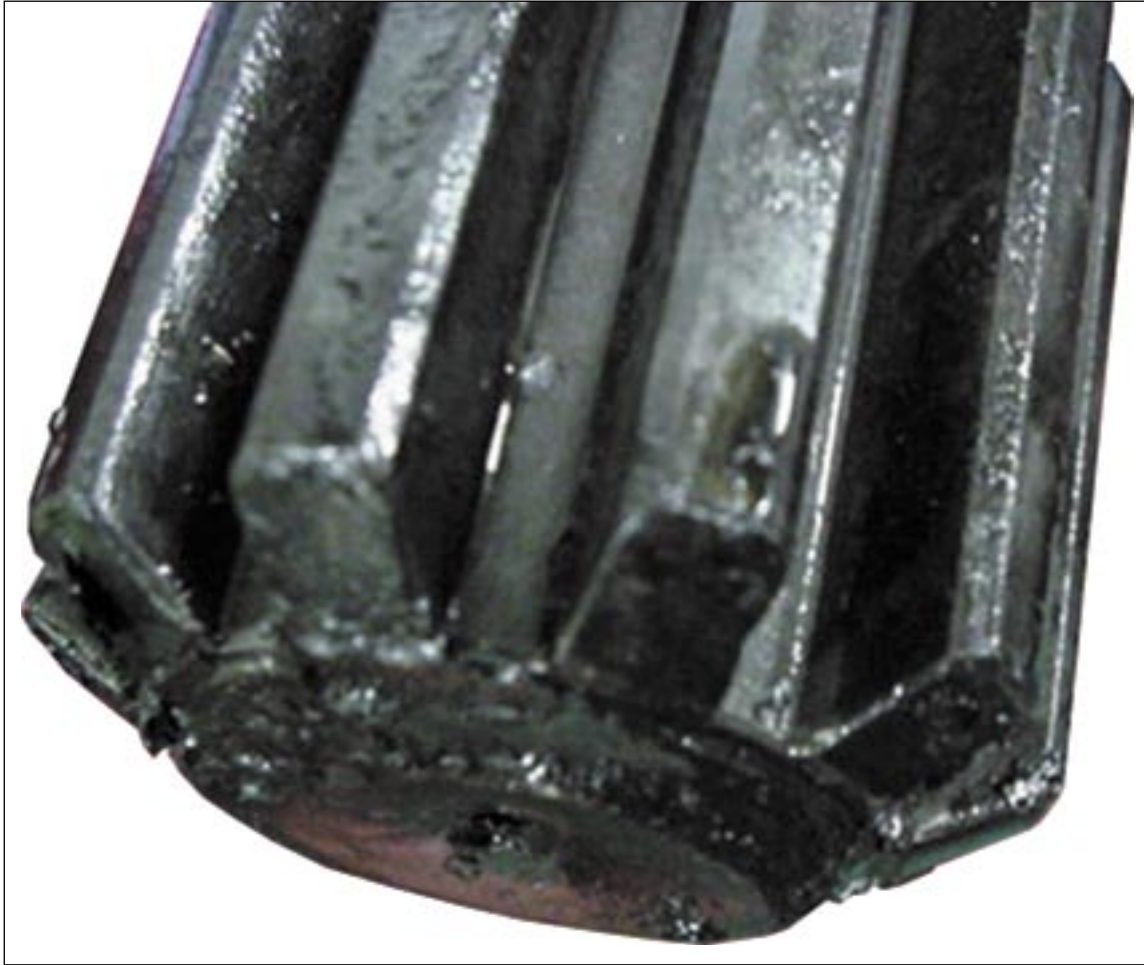


Error code B1



F. SHANK ADAPTER FAILURES

F:1 IMPACT MARKS, CHIPPED OR RIVETED END



Error code C2

F. SHANK ADAPTER FAILURES

F:3 WEAR IN BOTTOM OF SPLINE SHOULDER (common in bench drilling)



Error code C3

F. SHANK ADAPTER FAILURES

F:4 FAILURE AT FRONT HEAD



Error code Kxx/Nxx

F. SHANK ADAPTER FAILURES

F:5 FAILURE IN THREADS



Error code Kxx

F. SHANK ADAPTER FAILURES

F:6 FAILURE AT FRONT BUSHING



Error code Kxx

F. SHANK ADAPTER FAILURES

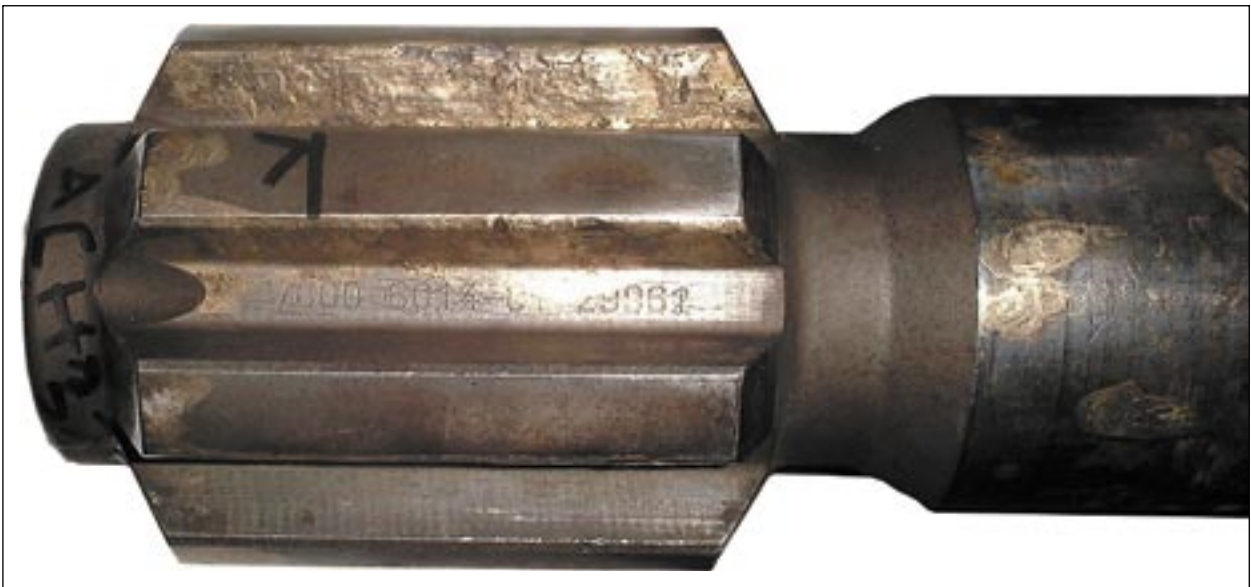
F:7 CORROSION



Error code Kxx

F. SHANK ADAPTER FAILURES

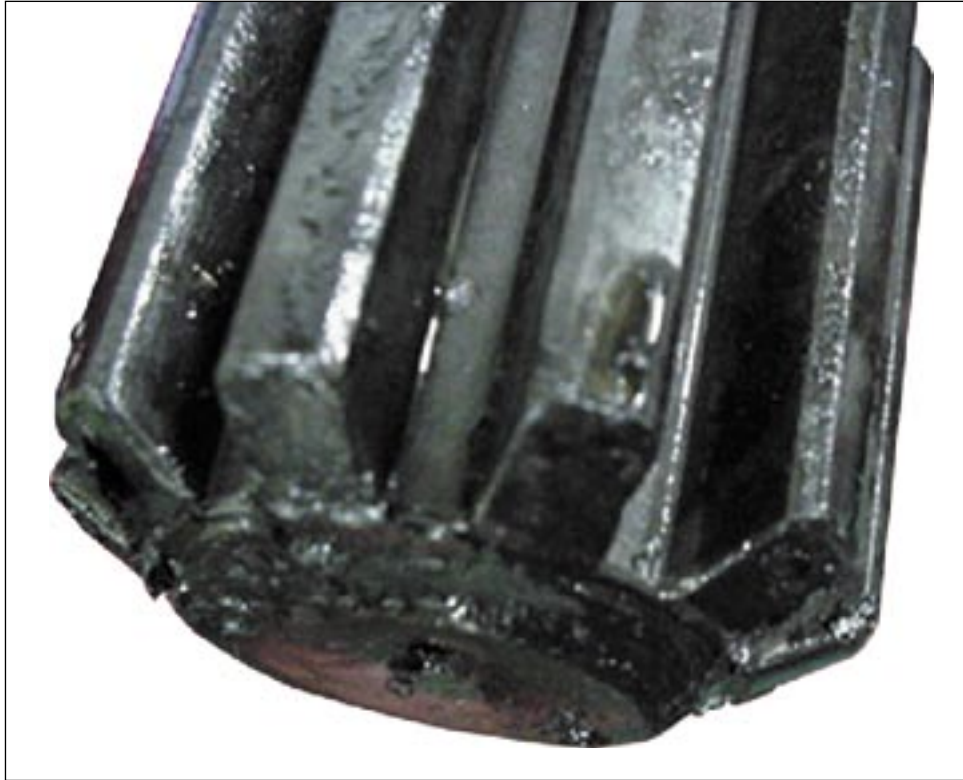
F:9 PITTING AND GALLING ON SPLINES



Error code C3

F. SHANK ADAPTER FAILURES

F:10 EXCESSIVE WEAR ON TOP OF SPLINE SHOULDER



Error code C3

F. SHANK ADAPTER FAILURES

F:11 CHIPPED THREAD END



Error code B4

G. COUPLING SLEEVE FAILURES

G:1 IMPACT MARKS, CHIPPED END



Error code B4

G. COUPLING SLEEVE FAILURES

G:2 LONGITUDINAL CRACK



Error code B2

H. TAPERED ROD & INTEGRAL FAILURES

H:2 STRIKING FACE DEFORMED



Error code C2

H. TAPERED ROD & INTEGRAL FAILURES

H:3 WEAR OR BREAKAGE AT BEGINNING OF COLLAR RADIUS



Error code B1

H. TAPERED ROD & INTEGRAL FAILURES

H:8 FAILURE IN THE JOINT



Error code L

H. TAPERED ROD & INTEGRAL FAILURES

H:9 FAILURE IN THE WING



Error code F

H. TAPERED ROD & INTEGRAL FAILURES

H:10 FAILURE IN THE CARBIDE



Error code S

H. TAPERED ROD & INTEGRAL FAILURES

H:11 PROPELLER WEAR





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