

PSC HAND SAFETY INDIA · TECHNICAL GUIDE

HAND EXPOSURE IN INTEGRATED STEEL PLANTS

A Department-by-Department Engineering Guide to Identifying and Reducing Hand Exposure

COVERAGE — 22 DEPARTMENTS

- | | | |
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| 01 Raw Material Handling | 02 Coke Oven & Coal Chemical | 03 Sinter Plant |
| 04 Pellet Plant | 05 Blast Furnace | 06 Steel Melting Shop |
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Hand Exposure in Integrated Steel Plants

A Department-by-Department Engineering Guide to Identifying and Reducing Hand Exposure

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This guide is intended to support hazard identification, task review and the development of safer methods of work. It does not replace site-specific risk assessments, operating procedures, equipment-manufacturer instructions or statutory safety requirements.

Illustrations, task observations and control concepts are presented for educational and engineering-review purposes. Individual applications must be assessed by competent personnel before implementation.

Why This Guide Exists

Hand injuries in steel plants are rarely caused by a lack of awareness alone. In many tasks, the worker understands the hazard but must still place a hand close to the load, component, tool or contact point in order to complete the work.

The exposure commonly occurs during the final stage of an activity: guiding, aligning, seating, holding, steadying, clearing, positioning or confirming that a component is correctly located.

This guide examines those moments department by department. Its purpose is not merely to describe hazards, but to ask a more useful engineering question:

Why must the hand enter the hazard zone at all?

By identifying the task, the point of interaction and the reason for hand entry, plants can move beyond dependence on gloves, warnings and worker behaviour alone. The objective is to redesign the interaction wherever reasonably practicable so that the hand is separated from the hazard.

This is the central principle of the guide:

Engineer the hand out of the hazard.

How to Use This Guide

Each departmental section should be reviewed using five questions:

- 1 **What is the task being performed?**
- 2 **Where does the hand enter the exposure zone?**
- 3 **What hazard exists at that point?**
- 4 **Why is direct hand contact currently required?**
- 5 **What engineered interface, method change or tool could remove or reduce that contact?**

THIS GUIDE MAY BE USED FOR

- Task-based risk assessments
- Maintenance planning
- Incident investigation
- Procurement specifications
- Toolbox discussions
- Shutdown preparation
- Engineering-control reviews
- Hand-safety improvement projects

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The Central Finding

Across steelmaking, material handling, maintenance and finishing operations, hand exposure most often occurs not during the main movement of the load, but during the final interaction.

It occurs when a worker:

- guides
- steadies
- pushes
- pulls
- aligns
- holds
- seats
- releases
- clears
- confirms position

These actions may appear minor, but they place the hand closest to pinch points, crush zones, impact paths, sharp edges, hot surfaces and stored energy.

The question should therefore not stop at:

Was the worker wearing the correct glove?

The stronger question is:

Why was the hand required to be there?

From PPE to Engineered Separation

Gloves remain essential, but they act after the hand has already entered the exposure zone.

A stronger control strategy follows the hierarchy:

- 1 Eliminate unnecessary hand contact.
- 2 Redesign the task or component.
- 3 Introduce an engineered handling interface.
- 4 Increase stand-off distance.
- 5 Improve the method of work.
- 6 Use PPE for the residual risk.

The goal is not to remove worker judgement. It is to give the worker a safer interface through which that judgement can be applied.

Large machines, lifting systems and production processes are engineered in detail. The final point of human interaction deserves the same level of engineering attention.

Plant-Level Hand Exposure Review

- ☐ Have high-frequency hand-entry tasks been identified?
- ☐ Are workers manually guiding loads during the final 300 mm of movement?
- ☐ Are hands used to align, seat or hold components?
- ☐ Are improvised bars, pipes or makeshift tools being used?
- ☐ Are workers required to hold items while another person strikes or moves them?
- ☐ Are sharp, hot, oily, magnetic or unstable components handled directly?
- ☐ Can distance be introduced between the hand and the hazard?
- ☐ Can a dedicated interface replace direct contact?
- ☐ Are engineering controls included in procurement specifications?
- ☐ Are repeat hand injuries being investigated as system-design failures?

A hand-safe plant is not created only by asking workers to be more careful. It is created by systematically reducing the number of tasks in which the hand must enter the hazard zone.

About PSC Hand Safety India

PSC Hand Safety India develops and supplies engineered tools and task interfaces intended to reduce direct hand exposure during industrial operations.

Its work covers applications involving:

- Load guiding and positioning
- Push-and-pull operations
- Magnetic handling
- Striking and flogging activities
- Cylinder handling
- Suspended-load control
- Manual component handling
- Pipe and tubular movement
- Sling and shackle handling
- Maintenance and shutdown work

PSC has worked with steel plants, oil and gas operators, fabrication facilities, shipyards, power plants, mining operations and heavy-industry maintenance teams.

*Wherever practical, **interact with the load — not the hazard.***

Begin With the Task

Share the task, the point of hand exposure and the existing method of work. PSC can assist in reviewing whether a safer handling interface or greater stand-off distance may be introduced.

We work from the task outward — identifying where direct hand contact currently occurs, why it occurs, and what engineered alternative may be introduced. No obligation. No generic catalogue. Just a practical review of your specific task.

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CHAPTER 01 OF 22

Raw Material Handling Plant

This chapter identifies typical manual hand exposure scenarios encountered in this department of an integrated steel plant and highlights representative PSC application solutions commonly used for similar industrial tasks. Final product selection should always consider the specific task, component geometry, operating environment and site risk assessment.

1 DEPARTMENT OVERVIEW

Facilitator opening: Ask the audience how many have walked through the RMHP on a site visit. Most will have. Then ask how many have spent a full shift there watching the work. Very few will have. That gap — between knowing what the department does and understanding how people work in it — is exactly what this chapter addresses.

The Raw Material Handling Plant is the entry point for every tonne of material that will eventually become steel. Iron ore, coal, limestone, dolomite, coke, and fluxes arrive by rail, road, or ship, and are received, weighed, stockpiled, blended, and dispatched to downstream departments on demand. Nothing in the plant can run without a continuous, correctly-specified feed from the RMHP.

From a hand safety perspective the RMHP presents three compounding factors: the scale of continuous material movement means workers interact with conveyor systems, tipplers, stackers, and transfer stations almost continuously; the department is often perceived as "just bulk handling," so engineering controls for hand safety have historically received less investment than in process-critical departments; and a large contractor population rotates through for housekeeping, sampling, and maintenance work with variable hand safety training.

2 MAJOR EQUIPMENT

WAGON TIPPLER

Rotary or side-discharge device that inverts rail wagons to empty ore, coal, or limestone into receiving hoppers. Workers interact with wagon couplings, latching mechanisms, and the tippler platform before and after inversion.

STACKER & RECLAIMER

Large travelling machines that build and retrieve stockpiles using a rotating bucket wheel. Maintenance workers access the boom, bucket wheel, and slew ring — working at height near cutting edges and drive mechanisms.

CRUSHERS & SCREENS

Jaw, gyratory, and cone crushers reduce ore and coal to the required size fraction. Maintenance — liner replacement, screen deck renewal, chute clearing — involves heavy component handling inside crusher housings.

BELT CONVEYORS

Kilometres of conveyor infrastructure connecting receiving points, stockyards, and transfer stations. Hand exposure occurs at idler replacement, belt splicing, skirt board adjustment, and blockage clearance tasks across the network.

TRANSFER TOWERS & CHUTES

Enclosed structures where material transfers between conveyors, often changing direction or elevation. Chute liners wear rapidly and require frequent manual replacement in confined, dusty spaces.

VIBRATING FEEDERS & SAMPLING STATIONS

Feeders extract material from hoppers at a controlled rate. Manual sampling stations require operators to sweep a hand-held cutter across the material stream on a running belt where automatic samplers are absent.

3

MANUAL TASKS & HAND EXPOSURE SCENARIOS

• HIGH		
Wagon Tippler — Coupling & De-coupling		
PINCH / CRUSH		
WHY THE HAND IS THERE	HAND INTERFACE	EXPOSURE TYPE
Worker manually connects or disconnects wagon couplings before and after tipping. The coupling is heavy, spring-loaded, and requires force to engage or release.	Wagon coupling knuckle, coupling pin, tippler platform latch, wagon body edge	Pinch between coupling components; crush between wagon body and tippler platform during rotation initiation
"At what point in the tipping cycle is the worker still physically in contact with the wagon? Is that contact necessary, or is it a habit that has never been challenged?"		
ENGINEERING INTERFACE CONSIDERATION		
Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.		

• HIGH		
Conveyor Belt — Idler Roller Replacement		
CAUGHT-BETWEEN / PINCH		
WHY THE HAND IS THERE	HAND INTERFACE	EXPOSURE TYPE
Worker lifts the belt manually with one hand to extract the worn idler and insert the replacement. The belt is heavy, under tension, and the gap between belt and frame is narrow.	Conveyor belt underside, idler roller shell, idler frame bracket, belt lifting device	Hand caught between belt and roller during re-tensioning; finger trapped in idler bracket during extraction
"How is the belt held up during idler change in your plant today? Is that method consistent across all conveyor lines, or does it vary by crew?"		
ENGINEERING INTERFACE CONSIDERATION		
Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.		

3MANUAL TASKS & HAND EXPOSURE SCENARIOS — CONTINUED

MEDIUM

Transfer Chute — Liner Plate Replacement

CRUSH / IMPACT

WHY THE HAND IS THERE Wear liner plates (15–40 kg) must be manually positioned inside the chute box and held while bolts are inserted. Confined geometry forces the worker into awkward positions with hands between plate and chute wall.	HAND INTERFACE Liner plate face and edges, chute wall, bolt hole alignment points, impact bar retainer	EXPOSURE TYPE Crush between liner and chute wall during positioning; impact from dropped liner; pinch at bolt hole during alignment
--	--	---

"Inside a transfer chute there is usually no room for a mechanical aid. What is the current practice for getting a 30 kg liner into position without trapping a hand?"

ENGINEERING INTERFACE CONSIDERATION

Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.

• HIGH

Crusher — Jaw Plate & Liner Replacement**CRUSH / STRUCK-BY****WHY THE HAND IS THERE**

Jaw plates require crane assistance but are seated manually — hands between the component and the crusher frame during final positioning.

HAND INTERFACE

Jaw plate face, crusher frame, toggle block, crane hook and sling during landing

EXPOSURE TYPE

Hand crushed between jaw plate and frame during seating; struck-by if sling slips during crane landing

"When a jaw plate is being lowered into the crusher on a crane, at what point do workers' hands make contact with it? Could that contact be eliminated entirely?"

ENGINEERING INTERFACE CONSIDERATION

Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.

• MEDIUM

Stacker-Reclaimer — Bucket Wheel & Boom Maintenance**CAUGHT-BETWEEN / LINE-OF-FIRE****WHY THE HAND IS THERE**

Bucket teeth, boom idlers, and slew ring lubrication points require workers to reach into the machine at height. Bucket replacement requires manual positioning and bolt alignment.

HAND INTERFACE

Bucket lip and tooth, bucket mounting flange, boom structure frame, slew ring gear teeth

EXPOSURE TYPE

Hand in line of fire of bucket movement during manual wheel indexing; caught between slew ring teeth during lubrication

"On a bucket wheel, how is the wheel indexed to the next position during maintenance? Is that done mechanically or does someone push the wheel by hand?"

ENGINEERING INTERFACE CONSIDERATION

Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.

• HIGH

Hopper & Bin — Blockage Clearing**LINE-OF-FIRE / STRUCK-BY****WHY THE HAND IS THERE**

Wet material forms arches inside hoppers and surge bins. Workers insert rods or their arms through inspection openings to break the blockage — often while the downstream conveyor is still running.

HAND INTERFACE

Hopper opening edge, clearing rod, material face, feeder grate below

EXPOSURE TYPE

Hand buried when blockage releases suddenly (engulfment); struck by material surge; caught on feeder grate

"When a blockage occurs at 2am, what actually happens? Not what the procedure says — what actually happens. That gap is where the worst hand injuries occur."

ENGINEERING INTERFACE CONSIDERATION

Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.

• MEDIUM

Vibrating Screen — Screen Deck Replacement

CRUSH / ABRASION

WHY THE HAND IS THERE	HAND INTERFACE	EXPOSURE TYPE
Screen panels (15–60 kg) must be lowered through the screen body with limited access clearance. Retaining bolts and tensioning bars must be positioned and engaged by hand.	Screen panel edges (wire mesh or polyurethane), side tensioning bar, retaining bolt, screen body inner frame	Hand crushed between panel and frame during positioning; abrasion on wire mesh edges; pinch under tensioning bar

"How many screen decks does your plant replace per month? Has anyone mapped the hand positions required during the full change sequence?"

ENGINEERING INTERFACE CONSIDERATION

Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.

4 SHUTDOWN & OVERHAUL — ADDITIONAL EXPOSURE

TASK	HAND EXPOSURE	SEVERITY	EXPOSURE	PSC ENGINEERING INTERFACE CATEGORY
Complete belt replacement	Threading belt around pulleys and through frame openings; multiple crews on same line	HIGH	CAUGHT-BETWEEN	PSC Load Control Interfaces · PSC Position & Reach Interfaces

TASK	HAND EXPOSURE	SEVERITY	EXPOSURE	PSC ENGINEERING INTERFACE CATEGORY
Head / tail pulley replacement	Crane-lifted pulley; hand guides shaft into bearing housing; limited clearance	HIGH	CRUSH	PSC Position & Reach Interfaces

TASK	HAND EXPOSURE	SEVERITY	EXPOSURE	PSC ENGINEERING INTERFACE CATEGORY
Gearbox overhaul (feeder/stacker)	Gear sets and shafts handled manually; hand inside casing during inspection	LOW	PINCH / CUT	PSC Load Control Interfaces · PSC Magnetic Handling Interfaces · PSC Position & Reach Interfaces

TASK	HAND EXPOSURE	SEVERITY	EXPOSURE	PSC ENGINEERING INTERFACE CATEGORY
Bucket wheel tooth replacement	Hand steadies tooth during welded or bolted fitting at height on bucket wheel	LOW	BURNS / CRUSH	PSC Position & Reach Interfaces · PSC Striking & Alignment Interfaces

5 CONTRACTOR & MOBILE EQUIPMENT INTERFACES

ACTIVITY / EQUIPMENT	HAND EXPOSURE SCENARIO	EXPOSURE	PSC ENGINEERING INTERFACE CATEGORY
Rigging & lifting crew	Hand on sling and shackle during load attachment, release, and suspended component guidance to landing point	LINE-OF-FIRE	PSC Load Control Interfaces

ACTIVITY / EQUIPMENT	HAND EXPOSURE SCENARIO	EXPOSURE	PSC ENGINEERING INTERFACE CATEGORY
Conveyor maintenance contractor	Idler replacement, belt splicing, scraper blade change — continuous hand contact with belt, frame, and components	PINCH CUT	PSC Manual Lifting Interfaces · PSC Position & Reach Interfaces · PSC Striking & Alignment Interfaces

ACTIVITY / EQUIPMENT	HAND EXPOSURE SCENARIO	EXPOSURE	PSC ENGINEERING INTERFACE CATEGORY
Mobile crane (maintenance lifts)	Hand guidance of suspended components during landing on equipment throughout shutdown	CRUSH	PSC Load Control Interfaces · PSC Position & Reach Interfaces

ACTIVITY / EQUIPMENT	HAND EXPOSURE SCENARIO	EXPOSURE	PSC ENGINEERING INTERFACE CATEGORY
Forklift / wheel loader	Worker manually positions pallet or material to allow machine approach; steadying load during fork travel	PINCH	PSC Position & Reach Interfaces

6 RMHP QUICK ASSESSMENT CHECKLIST

Use during a plant walkdown or shutdown planning session. Answer based on current observed practice, not the written procedure.

- ☐ Do workers guide suspended crusher liners or jaw plates by hand during crane landing?
- ☐ Are anti-tangle taglines used on all RMHP crane lifts — including maintenance lifts during shutdown?
- ☐ Are liner plates manually held inside transfer chutes during bolting operations?
- ☐ Are hopper and bin blockages cleared with extended-reach tools — or with hands inserted into the opening?
- ☐ Are idler rollers manually carried to the replacement point without an ergonomic handling interface?
- ☐ Are suspended loads on the RMHP controlled throughout the full landing sequence, including the last 300 mm?
- ☐ Are fasteners and pins held by hand during hammer-driven alignment in RMHP maintenance work?
- ☐ Does the contractor induction for RMHP work include a task-specific hand exposure review?

If you answered **Yes** to any of the above, PSC can review those tasks and recommend representative hands-free engineered interfaces. Contact Shivani at **+91-96031-66448** or **sales@pschandsafety.com**

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PSC ENGINEERING INTERFACE PORTFOLIO — RAW MATERIAL HANDLING PLANT

Representative PSC interfaces for the hand exposure scenarios identified in this chapter. Contact PSC for the full range and for engineering guidance specific to your application and site conditions.

LOAD CONTROL INTERFACES				
INTERFACE	PRIMARY RMHP APPLICATION	REP. SIZES	PART NUMBERS	SCENARIOS
PSC Load Control Interfaces	Controlling suspended loads — jaw plates, pulleys, liners — during all RMHP crane operations	20 ft, 25 ft, 30 ft	PSC Load Control Interfaces	4 · 5 · Shutdown
INTERFACE	PRIMARY RMHP APPLICATION	REP. SIZES	PART NUMBERS	SCENARIOS
PSC Load Control Interfaces · PSC Position & Reach Interfaces	High-visibility, chemical-resistant tagline for outdoor RMHP; knot-free, retains shape	20 ft, 25 ft, 30 ft	PSC-WEB-TLD-120 PSC-WEB-TLD-125	5 · Shutdown
INTERFACE	PRIMARY RMHP APPLICATION	REP. SIZES	PART NUMBERS	SCENARIOS
PSC Load Control Interfaces	Attaching and retrieving taglines from loads without entering the suspended load zone; 25kN swivel hook	10 m, 15 m, 20 m	PSC Load Control Interfaces	Contractor
POSITION & REACH INTERFACES				
INTERFACE	PRIMARY RMHP APPLICATION	REP. SIZES	PART NUMBERS	SCENARIOS
PSC Load Control Interfaces · PSC Position & Reach Interfaces	Guiding crusher jaw plates, pulleys, gearboxes during crane landing; bucket wheel indexing; hopper blockage clearing at reach	42", 50", 72", 96"	PSC Position & Reach Interfaces	1 · 4 · 5 · 6
INTERFACE	PRIMARY RMHP APPLICATION	REP. SIZES	PART NUMBERS	SCENARIOS
Guide-It® Push/Pull Pole	Heavy-duty nylon head; guiding and spotting suspended loads during maintenance lifts throughout RMHP	42", 50", 72", 96"	PSC Position & Reach Interfaces	4 · Contractor
INTERFACE	PRIMARY RMHP APPLICATION	REP. SIZES	PART NUMBERS	SCENARIOS
PSC Load-It® Push Pull Tool	Belt end positioning during splicing; belt lifting during idler change; scraper blade positioning	4 ft, 6 ft, 8 ft	PSC Position & Reach Interfaces	2 · Shutdown
INTERFACE	PRIMARY RMHP APPLICATION	REP. SIZES	PART NUMBERS	SCENARIOS
3P Xtend Tool	Extended-reach blockage clearing in hoppers and chutes; extends to 12 ft without entering the hazard zone	6 ft / 12 ft extended	PSC Load Control Interfaces	6
INTERFACE	PRIMARY RMHP APPLICATION	REP. SIZES	PART NUMBERS	SCENARIOS
PSC SafeGuider Tool	PSC Load Control Interfaces	3 ft, 4 ft, 6 ft	PSC Position & Reach Interfaces	Contractor
MAGNETIC HANDLING INTERFACES				

7

PSC ENGINEERING INTERFACE PORTFOLIO — RAW MATERIAL HANDLING PLANT — CONTINUED

INTERFACE	PRIMARY RMHP APPLICATION	REP. SIZES	PART NUMBERS	SCENARIOS
PSC Load-It® Mag (Non-Extendable · 500 lbs)	Magnetically gripping and positioning ferrous liner plates, screen panels — eliminates hand contact on heavy steel faces and edges	4 ft, 6 ft, 8 ft	PSC Magnetic Handling Interfaces · PSC Position & Reach Interfaces	3 · 7

INTERFACE	PRIMARY RMHP APPLICATION	REP. SIZES	PART NUMBERS	SCENARIOS
PSC Load-It® Mag Extendable (275 lbs)	Reach-in magnetic positioning inside confined transfer chutes and crusher housings where fixed-length tools cannot access	4 to 8 ft adjustable	PSC Position & Reach Interfaces	3 · Shutdown

STRIKE & ALIGN INTERFACES

INTERFACE	PRIMARY RMHP APPLICATION	REP. SIZES	PART NUMBERS	SCENARIOS
PSC Striking & Alignment Interfaces	Holding bolts, pins, and fasteners during hammer-driven alignment; liner bolt insertion; belt splice fastener driving	295 mm, 375 mm, 850 mm	PSC Striking & Alignment Interfaces	3 · Shutdown

INTERFACE	PRIMARY RMHP APPLICATION	REP. SIZES	PART NUMBERS	SCENARIOS
PSC RiggerMate® Hook	Pushing, pulling, and positioning ropes, chains, and sling eyes without direct hand contact at rigging interfaces	Single size	PSC Load Control Interfaces	1 · Contractor

INTERFACE	PRIMARY RMHP APPLICATION	REP. SIZES	PART NUMBERS	SCENARIOS
PSC Chisel & Punch Holder	Holding chisels during concrete breaking and structural repair; removes holding hand from strike zone entirely	Fits chisels to 1" dia.	PSC Striking & Alignment Interfaces	Contractor

MANUAL HANDLING INTERFACES

INTERFACE	PRIMARY RMHP APPLICATION	REP. SIZES	PART NUMBERS	SCENARIOS
PSC Lift Assist® Single Handle	Carrying idler rollers and small maintenance components without gripping sharp or heavy component edges directly	50 mm × 900 mm	PSC Manual Lifting Interfaces	2 · Contractor

INTERFACE	PRIMARY RMHP APPLICATION	REP. SIZES	PART NUMBERS	SCENARIOS
PSC Lift Assist® Double Handle	Two-person carrying of screen panels, belt sections, and heavier maintenance components without edge grip	50 mm × 1500 mm	PSC Manual Lifting Interfaces	7

INTERFACE	PRIMARY RMHP APPLICATION	REP. SIZES	PART NUMBERS	SCENARIOS
PSC Specialised Maintenance Interfaces	Safe handling of oxygen, acetylene, and argon cylinders in maintenance and welding areas across the RMHP	230 mm, 254 mm	PSC Specialised Maintenance Interfaces	Contractor

— APPLICATION-SPECIFIC ENGINEERING GUIDANCE

If any hand exposure scenario in this chapter reflects tasks in your plant, PSC Hand Safety India can provide a engineering guidance indication for representative interfaces listed in this chapter. A engineering guidance is a starting point for evaluating whether an engineered interface is worth pursuing — it is not a binding commitment.

INFORMATION TO PROVIDE

1. Department / plant area (e.g. RMHP — Transfer Chute)
2. Specific task or hand exposure scenario
3. Component weight and dimensions (approximate)
4. Tool length or reach required
5. Whether the component is ferrous (magnetic applicable)
6. Indicative quantity of interfaces required
7. Plant name and location (for logistics estimate)

WHAT PSC PROVIDES

- Recommended interface and size for the task
- Indicative unit price (budgetary, not binding)
- Delivery lead time from Visakhapatnam
- Application notes for the specific scenario
- Trial order option for field evaluation
- Reference to comparable applications in similar plants

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Chapter 1 of 22 · Version 2

ENGINEER THE HAND OUT OF THE HAZARD™

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Coke Oven & Coal Chemical Plant

This chapter identifies typical manual hand exposure scenarios encountered in this department of an integrated steel plant and highlights representative PSC application solutions commonly used for similar industrial tasks. Final product selection should always consider the specific task, component geometry, operating environment and site risk assessment.

1 DEPARTMENT OVERVIEW

Facilitator opening: Ask the audience when they last conducted a hand exposure review specifically in the coke oven plant. In most plants this department receives extensive attention for gas hazards, fire risk, and respiratory protection — but hand exposure analysis at the task level is rarely documented. That gap is the starting point for this chapter.

The Coke Oven and Coal Chemical Plant converts coking coal into metallurgical coke — the primary fuel and reducing agent for the blast furnace. Coal is blended, crushed, and charged into sealed ovens where it is carbonised at temperatures exceeding 1,000°C for 16 to 20 hours. The resulting coke is pushed from the oven, quenched, screened, and transferred to the blast furnace stockyard. Simultaneously, the gases driven off during carbonisation are recovered, cleaned, and separated into valuable by-products including benzene, toluene, naphthalene, tar, ammonium sulphate, and coke oven gas — which itself becomes a fuel for the plant's heating systems.

From a hand safety perspective, the coke oven plant presents conditions not found in most other departments: extreme radiant heat, corrosive chemical exposure, large mechanical forces on oven door and lid components, heavy refractory materials, and high-pressure gas and liquid systems. Workers operate in shifts around the clock, often in poor visibility, and a significant proportion of maintenance work — particularly oven door maintenance and refractory repair — involves manual handling of heavy, hot, or chemically contaminated components in confined or awkward positions.

2 MAJOR EQUIPMENT

COKE OVEN BATTERIES & OVENS

Banks of sealed silica-brick ovens typically 6–7 metres tall. Each oven has a pusher-side door and a coke-side door. Workers interact with doors, lids, standpipes, and ascension pipes during charging, pushing, and maintenance operations.

PUSHER MACHINE & LEVELLER BAR

Pushes the hot coke cake from the oven into the quench car. The leveller bar enters the oven through the pusher-side door to level the coal charge. Workers interact with door extraction mechanisms, latch systems, and leveller bar couplings.

OVEN DOORS & DOOR FRAMES

Cast-iron doors that seal each end of the oven. They accumulate graphite and carbon deposits that must be manually cleaned. Door frame jambs are scraped and wire-brushed during every push cycle. Door weight typically 800–1200 kg; handled by door extractor machine but manual intervention is frequent.

CHARGING CAR

Rail-mounted vehicle that carries coal from the coal tower and charges it into the oven through lids on the oven roof. Workers manually position and remove charging lids; lid lifting and sealing operations involve direct hand contact with hot, contaminated cast-iron components.

COKE GUIDE & QUENCH CAR

The coke guide directs the hot coke cake into the quench car below as it is pushed from the oven. Workers interact with guide alignment, coupling pins, and structural adjustment points — near extremely hot coke.

BY-PRODUCT RECOVERY PLANT

Network of gas mains, coolers, tar separators, scrubbers, stills, and chemical storage vessels. Maintenance involves valve operation, flange work, pump overhaul, and sampling — in an environment of hot, corrosive, and toxic liquids and gases.

3

MANUAL TASKS & HAND EXPOSURE SCENARIOS

• HIGH		
Oven Door — Extraction, Cleaning & Replacement		BURNS / CRUSH / IMPACT
WHY THE HAND IS THERE After the door extractor removes the door, workers manually scrape carbon and graphite deposits from the door sealing face and frame jamb using scraper bars and wire brushes. The door face and jamb are hot, contaminated, and often irregular.	HAND INTERFACE Door sealing face (hot cast iron), scraper bar handle, wire brush handle, door frame jamb, door latch mechanism	EXPOSURE TYPE Burns from residual heat on door face; hand crushed between door and frame during re-engagement; impact from scraper bar slip on irregular surface
<i>"During a door-cleaning cycle, at what point is the worker's hand closest to the door face? Is there a minimum clearance maintained, or does the hand contact the door surface directly?"</i>		
ENGINEERING INTERFACE CONSIDERATION Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.		

• HIGH		
Charging Lid — Lifting, Positioning & Reseating		BURNS / PINCH
WHY THE HAND IS THERE Charging lids on the oven roof must be manually lifted and repositioned to allow coal charging, then reseated and sealed after charging. Lids weigh 40–80 kg and are hot. Workers grip the lid handles or edges directly.	HAND INTERFACE Charging lid handle and rim (hot cast iron or steel), lid seating flange, seal ring, charging car structure	EXPOSURE TYPE Burns from hot lid surface; pinch between lid and frame during reseating; hand contact with hot sealing compound around lid rim
<i>"How is the charging lid gripped during lifting and reseating? Is a purpose-built lid handling tool used, or do workers grip the lid body directly?"</i>		
ENGINEERING INTERFACE CONSIDERATION Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.		

3MANUAL TASKS & HAND EXPOSURE SCENARIOS — CONTINUED

HIGH

Standpipe & Ascension Pipe — Lid Removal & Cleaning

BURNS / LINE-OF-FIRE

WHY THE HAND IS THERE Standpipe and ascension pipe lids must be manually opened and closed during charging and pushing operations. Carbon and tar deposits build up on lid seats and must be manually cleared. Escaping gas makes visibility poor and increases urgency. <i>"Is the standpipe lid opened with a purpose-built tool that keeps the worker's hand away from the escaping gas stream, or is the hand positioned directly above the opening?"</i>	HAND INTERFACE Standpipe lid and handle (hot), lid lifting pole, ascension pipe flap, carbon scraper	EXPOSURE TYPE Burns from hot escaping gas and lid surface; hand in line of fire of escaping gas/steam during lid opening; falling lid if grip fails
ENGINEERING INTERFACE CONSIDERATION Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.		

• HIGH

Oven Door Lining & Frame —
Refractory Repair

CRUSH / BURNS / ABRASION

WHY THE HAND IS THERE

Refractory bricks and castable lining inside the door body and around the door frame must be replaced manually. Bricks (2–8 kg each) are handled individually and positioned by hand in confined spaces with residual heat.

HAND INTERFACE

Refractory brick faces and edges, castable lining surface, door body interior frame, trowel and pointing tool handles

EXPOSURE TYPE

Abrasion and cuts on refractory brick edges; burns from hot residual surfaces; hand crushed between brick and frame during placement

"During door lining repair, what is the maximum residual temperature at which workers are permitted to handle the door body? Is that limit actually measured or estimated?"

ENGINEERING INTERFACE CONSIDERATION

Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.

• MEDIUM

By-product Plant — Valve, Flange & Pump Maintenance

PINCH / BURNS / CHEMICAL

WHY THE HAND IS THERE

Valves, flanges, and pump casings in the tar, benzene, ammonia liquor, and gas main systems require regular manual maintenance. Workers handle bolts, gaskets, and pump components in spaces congested with pipework and in the presence of hot, corrosive, and toxic process streams.

HAND INTERFACE

Valve spindle, flange bolt and nut, pump impeller, gasket face, coupling half, pipe end

EXPOSURE TYPE

Pinch between flange faces during gasket positioning; chemical burns if residual liquor contacts skin; hand struck if spanner slips on corroded fastener

"When a flange is opened in the tar or ammonia liquor section, what procedure ensures the hand does not contact process residue? Is that procedure followed consistently during night shifts?"

ENGINEERING INTERFACE CONSIDERATION

Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.

• HIGH		
Coke Pushing — Guide Alignment & Quench Car Positioning		BURNS / LINE-OF-FIRE
WHY THE HAND IS THERE During the push cycle, the coke guide must be aligned with the oven opening and the quench car must be positioned correctly. Workers manually guide alignment, adjust pins and couplings, and signal machine operators from positions close to the hot coke discharge path.	HAND INTERFACE Guide alignment pin, coupling latch, quench car edge, signalling position near hot coke discharge	EXPOSURE TYPE Radiant burn from hot coke cake; hand in line of fire of coke discharge if guide misaligns; crush between guide structure and oven frame
<i>"During coke guide alignment, what is the minimum distance between the worker's hands and the coke discharge path? Is there a defined safe position, or does the worker judge it situationally?"</i>		
ENGINEERING INTERFACE CONSIDERATION Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.		

• MEDIUM		
Gas Main & Condensate Line — Sampling & Drain Valve Operation		LINE-OF-FIRE / CHEMICAL BURNS
WHY THE HAND IS THERE Process samples must be collected from gas mains and condensate lines. Drain valves must be manually operated to clear condensate. Workers position sampling containers and operate valves with hands near hot, pressurised, or toxic process streams.	HAND INTERFACE Sample valve handle, sampling vessel, drain valve wheel, condensate discharge point	EXPOSURE TYPE Hand in line of fire of pressurised condensate discharge; chemical burn from tar, ammonia liquor, or benzene contact; hand scalded by hot condensate splash
<i>"When condensate drain valves are opened, is the worker's hand positioned above, beside, or below the discharge point? What is the procedure for avoiding splash contact?"</i>		
ENGINEERING INTERFACE CONSIDERATION Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.		

• MEDIUM		
Coal Crusher & Screening — Maintenance Access		CRUSH / CUT / ABRASION
WHY THE HAND IS THERE Crusher liners, hammer bars, and screen decks in the coal preparation section require regular replacement. Components are heavy and abrasive — coal dust impregnated with fine mineral matter. Confined crusher housings force the hand between component and frame during positioning.	HAND INTERFACE Hammer bar face and edges, liner plate, screen panel wire mesh, crusher frame, retaining bolt	EXPOSURE TYPE Hand crushed between liner and frame; abrasion on worn screen mesh; pinch at bolt hole during alignment
<i>"Coal crusher maintenance is often done under time pressure between coking cycles. Is the maintenance sequence task-planned in advance, or does the crew improvise based on who is available?"</i>		
ENGINEERING INTERFACE CONSIDERATION Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.		

• HIGH		
Pusher Machine — Leveller Bar Coupling & Door Latch Mechanism		PINCH / CRUSH
WHY THE HAND IS THERE The leveller bar must be coupled and decoupled from the pusher machine during maintenance. Door latch mechanisms on the pusher side require manual engagement and release. These tasks are performed close to heavy moving machinery with residual heat from oven operations.	HAND INTERFACE Leveller bar coupling pin, latch mechanism handle, pusher machine structure, door extractor arm	EXPOSURE TYPE Pinch between coupling components during engagement; hand crushed between pusher machine arm and oven structure; impact from latch spring release
<i>"Is the leveller bar coupling procedure documented at the task level — specifying hand position during pin insertion and removal — or is it left to the operator's experience?"</i>		
ENGINEERING INTERFACE CONSIDERATION Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.		

• MEDIUM

Gas Cylinder Handling — Maintenance & By-product Operations

CRUSH / STRUCK-BY

WHY THE HAND IS THERE	HAND INTERFACE	EXPOSURE TYPE
Oxygen, nitrogen, and specialty gas cylinders are moved frequently in the by-product plant and maintenance areas for welding, inerting, and laboratory use. Cylinders are moved by hand or trolley, and the hand grips the cylinder body directly for positioning and securing.	Cylinder body (smooth, often wet or contaminated), cylinder valve guard, cylinder base, regulator fitting	Crush between cylinder and structure during positioning; hand struck if cylinder falls or rolls; wrist injury from cylinder weight on confined grip

"In the by-product plant, where gas cylinder use is frequent, is there a standard method for moving and positioning cylinders — or does each crew use whatever grip works?"

ENGINEERING INTERFACE CONSIDERATION

Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.

• LOW

Tar Decanter & Still — Internal Access During Shutdown

BURNS / CHEMICAL / CONFINED SPACE

WHY THE HAND IS THERE	HAND INTERFACE	EXPOSURE TYPE
During planned shutdowns, tar decanters, stills, and scrubbers require internal inspection and cleaning. Workers enter or reach into vessels to remove scale, tar deposits, and packing material by hand — in the presence of residual corrosive material and heat.	Vessel interior wall, packing material, tar deposit, cleaning tool handle, manway flange	Chemical burns from residual tar and process liquors; hand contact with hot surfaces not fully cooled; laceration on internal structural edges

"What is the minimum cool-down and purge period before workers enter or reach into tar processing vessels? Is that period verified by temperature measurement or assumed from elapsed time?"

ENGINEERING INTERFACE CONSIDERATION

Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.

4 SHUTDOWN & OVERHAUL — ADDITIONAL EXPOSURE

TASK	HAND EXPOSURE	SEVERITY	EXPOSURE	PSC ENGINEERING INTERFACE CATEGORY
Oven silica brick relining	Individual bricks (3–5 kg) positioned by hand inside the hot oven shell; mortar applied manually to joints	LOW	BURNS / CRUSH	PSC Manual Lifting Interfaces · PSC Striking & Alignment Interfaces

TASK	HAND EXPOSURE	SEVERITY	EXPOSURE	PSC ENGINEERING INTERFACE CATEGORY
Oven door frame replacement	Door frames (300–600 kg) lifted by crane and landed onto battery structure; hand guidance during seating	LOW	CRUSH	PSC Load Control Interfaces · PSC Position & Reach Interfaces

TASK	HAND EXPOSURE	SEVERITY	EXPOSURE	PSC ENGINEERING INTERFACE CATEGORY
Gas main expansion joint replacement	Expansion bellows and flanges handled manually; bolt alignment in congested gas main corridor	LOW	PINCH / BURNS	PSC Position & Reach Interfaces · PSC Striking & Alignment Interfaces

TASK	HAND EXPOSURE	SEVERITY	EXPOSURE	PSC ENGINEERING INTERFACE CATEGORY
Coke oven machine overhaul	Pusher ram, leveller bar, and door extractor components removed and replaced; heavy parts handled by crane with manual guidance	LOW	CRUSH / PINCH	PSC Load Control Interfaces · PSC Position & Reach Interfaces

5 CONTRACTOR & MOBILE EQUIPMENT INTERFACES

ACTIVITY / EQUIPMENT	HAND EXPOSURE SCENARIO	EXPOSURE	PSC ENGINEERING INTERFACE CATEGORY
Refractory relining contractor	Oven brick laying and castable application — individual brick handling in confined hot oven space throughout the campaign	BURNS CRUSH	PSC Manual Lifting Interfaces · PSC Striking & Alignment Interfaces

ACTIVITY / EQUIPMENT	HAND EXPOSURE SCENARIO	EXPOSURE	PSC ENGINEERING INTERFACE CATEGORY
Rigging crew (oven machine components)	Sliding and guiding heavy machine components — pusher rams, door extractors — during crane maintenance lifts	LINE-OF-FIRE	PSC Load Control Interfaces

ACTIVITY / EQUIPMENT	HAND EXPOSURE SCENARIO	EXPOSURE	PSC ENGINEERING INTERFACE CATEGORY
By-product plant cleaning crew	Manual clearing of tar and scale deposits from vessel interiors, pipework, and drains; extended reach into confined spaces	BURNS CHEMICAL	PSC Load Control Interfaces · PSC Position & Reach Interfaces

5

CONTRACTOR & MOBILE EQUIPMENT INTERFACES — CONTINUED

ACTIVITY / EQUIPMENT	HAND EXPOSURE SCENARIO	EXPOSURE	PSC ENGINEERING INTERFACE CATEGORY
Mobile crane (shutdown lifts)	Hand guidance of door frames, machine components, and vessel internals during landing on battery structure	CRUSH	PSC Load Control Interfaces · PSC Position & Reach Interfaces

6

COCCP QUICK ASSESSMENT CHECKLIST

Use during a plant walkdown or shutdown planning session. Answer based on current observed practice.

- ☐ Are oven door sealing faces scraped with the worker's hand within reach of the hot door surface?
- ☐ Are charging lids lifted and reseated without a purpose-built lid-handling interface?
- ☐ Are standpipe and ascension pipe lids opened with the worker's hand positioned over the gas discharge path?
- ☐ During coke pushing, are workers' hands within 300 mm of the hot coke discharge path during guide alignment?
- ☐ Are fasteners and coupling pins held by hand during hammer-driven assembly in pusher machine maintenance?
- ☐ Are gas cylinders moved and positioned in the by-product plant by gripping the cylinder body directly?
- ☐ Are drain valve operations in the tar and ammonia sections performed without a standoff tool?
- ☐ During shutdown, are oven door frame crane lifts controlled with anti-tangle taglines throughout the full landing sequence?

If you answered **Yes** to any of the above, PSC can review those tasks and recommend representative hands-free engineered interfaces. Contact Shivani at **+91-96031-66448** or **sales@pschandsafety.com**

7 PSC ENGINEERING INTERFACE PORTFOLIO — COKE OVEN & COAL CHEMICAL PLANT

The following PSC engineering interfaces are relevant to the hand exposure scenarios identified in this chapter. This table introduces PSC product families and their primary engineering functions. It does not map any product to a specific scenario or application.

POSITION & REACH INTERFACES

INTERFACE	PRIMARY COCCP APPLICATION	REP. SIZES	PART NUMBERS	SCENARIOS
PSC Load Control Interfaces · PSC Position & Reach Interfaces	Door cleaning standoff; coke guide alignment; standpipe lid operation; hopper blockage clearing in coal prep; vessel access during shutdown	42", 50", 72"	PSC Position & Reach Interfaces	1-3-6-7-10
Guide-It® Push/Pull Pole	Guiding suspended door frames and machine components during crane landing throughout shutdown	42", 50", 72"	PSC Position & Reach Interfaces	Shutdown · Contractor
PSC SafeGuider Tool	Standpipe lid operation at extended reach; drain valve standoff; tar vessel access; tagline retrieval from near hot surfaces	3 ft, 4 ft, 6 ft	PSC Position & Reach Interfaces	3-4-10
3P Xtend Tool	Extended reach into tar vessels, drain sumps, and confined spaces during by-product plant cleaning; extends to 12 ft	6 ft / 12 ft extended	PSC Load Control Interfaces	10 · Contractor
PSC Load-It® Push Pull Tool	Door latch mechanism operation; leveller bar guidance; flange bolt alignment in congested by-product pipework	4 ft, 6 ft	PSC Position & Reach Interfaces	2-5-8

LOAD CONTROL INTERFACES

INTERFACE	PRIMARY COCCP APPLICATION	REP. SIZES	PART NUMBERS	SCENARIOS
PSC Load Control Interfaces	Controlling suspended door frames, machine components, and vessel parts during shutdown crane lifts	20 ft, 25 ft	PSC Load Control Interfaces	Shutdown · Contractor
PSC Load Control Interfaces	Attaching and retrieving taglines on heavy components — door frames, pusher machine parts — without entering the suspended load zone	10 m, 15 m	PSC Load Control Interfaces	Contractor

MAGNETIC HANDLING INTERFACES

7

PSC ENGINEERING INTERFACE PORTFOLIO — COKE OVEN & COAL CHEMICAL PLANT — CONTINUED

INTERFACE	PRIMARY COCCP APPLICATION	REP. SIZES	PART NUMBERS	SCENARIOS
PSC Load-It® Mag (Non-Extendable · 500 lbs)	Positioning ferrous crusher liners, hammer bars, and screen panels in coal preparation section; eliminates hand grip on heavy abrasive surfaces	4 ft, 6 ft	PSC Magnetic Handling Interfaces · PSC Position & Reach Interfaces	8

STRIKE & ALIGN INTERFACES

INTERFACE	PRIMARY COCCP APPLICATION	REP. SIZES	PART NUMBERS	SCENARIOS
PSC Striking & Alignment Interfaces	Holding coupling pins, bolts, and fasteners during hammer-driven assembly in pusher machine and door extractor maintenance; by-product plant flange work	295 mm, 375 mm, 850 mm	PSC Striking & Alignment Interfaces	1·5·8·Shutdown

INTERFACE	PRIMARY COCCP APPLICATION	REP. SIZES	PART NUMBERS	SCENARIOS
PSC Chisel & Punch Holder	Chisel work during refractory removal and door frame repair; removes holding hand from strike zone in hot, confined oven environment	Fits chisels to 1" dia.	PSC Striking & Alignment Interfaces	4 · Contractor

INTERFACE	PRIMARY COCCP APPLICATION	REP. SIZES	PART NUMBERS	SCENARIOS
PSC RiggerMate® Hook	Positioning sling eyes and chain hooks during machine component and door frame crane lifts without hand contact on rigging	Single size	PSC Load Control Interfaces	Contractor

MANUAL HANDLING INTERFACES

INTERFACE	PRIMARY COCCP APPLICATION	REP. SIZES	PART NUMBERS	SCENARIOS
PSC Lift Assist® Single Handle	Carrying individual refractory bricks, door components, and small maintenance parts without gripping hot or abrasive edges directly	50 mm × 900 mm	PSC Manual Lifting Interfaces	4 · Contractor

INTERFACE	PRIMARY COCCP APPLICATION	REP. SIZES	PART NUMBERS	SCENARIOS
PSC Lift Assist® Double Handle	Two-person carrying of heavier door lining sections and machine components during overhaul	50 mm × 1500 mm	PSC Manual Lifting Interfaces	4 · Shutdown

INTERFACE	PRIMARY COCCP APPLICATION	REP. SIZES	PART NUMBERS	SCENARIOS
PSC Specialised Maintenance Interfaces	Safe handling of oxygen, nitrogen, and specialty gas cylinders throughout by-product plant and maintenance areas	230 mm, 254 mm	PSC Specialised Maintenance Interfaces	9

— APPLICATION-SPECIFIC ENGINEERING GUIDANCE

If any hand exposure scenario in this chapter reflects tasks in your plant, PSC Hand Safety India can provide a engineering guidance indication for representative interfaces listed in this chapter. A engineering guidance is a starting point for evaluating whether an engineered interface is worth pursuing — it is not a binding commitment.

INFORMATION TO PROVIDE

1. Department / plant area (e.g. COCCP — Oven Door Cleaning)
2. Specific task or hand exposure scenario
3. Component weight and dimensions (approximate)
4. Tool length or reach required
5. Temperature of component at time of task
6. Indicative quantity of interfaces required
7. Plant name and location (for logistics estimate)

WHAT PSC PROVIDES

- Recommended interface and size for the task
- Indicative unit price (budgetary, not binding)
- Delivery lead time from Visakhapatnam
- Application notes for the specific scenario
- Trial order option for field evaluation
- Reference to comparable applications in similar plants

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Chapter 2 of 22 · Version 2

ENGINEER THE HAND OUT OF THE HAZARD™

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Sinter Plant

This chapter identifies typical manual hand exposure scenarios encountered in this department of an integrated steel plant and highlights representative PSC application solutions commonly used for similar industrial tasks. Final product selection should always consider the specific task, component geometry, operating environment and site risk assessment.

1 DEPARTMENT OVERVIEW

Facilitator opening: Ask the audience whether their sinter plant has a hand injury register separate from the rest of the plant — or whether sinter plant injuries are pooled into a site total. Most plants pool the data. When you separate it, the sinter plant typically appears as one of the highest hand-exposure departments in the entire integrated plant. That finding usually changes the conversation.

The Sinter Plant converts iron ore fines, coke breeze, limestone, dolomite, and plant waste materials — mill scale, flue dust, return fines — into a porous, lumpy material called sinter that is used as a primary feed material for the blast furnace. The raw mix is blended, moistened, and spread onto a continuously moving grate of steel pallet cars. The surface of the mix is ignited by gas-fired burners in the ignition hood, and the combustion front moves progressively downward through the bed as the pallet cars travel toward the discharge end. At discharge, the hot sinter cake breaks apart, is crushed, screened, and cooled before transfer to the blast furnace stockyard.

From a hand safety perspective, the sinter plant combines the hazards of bulk material handling — conveyor systems, crushers, screens — with the additional risks of hot sinter, pallet car mechanisms, wind box structures, and rotating grate machinery. The pallet car and its associated grate bar, side plate, and drive system components require regular maintenance and are among the most demanding manual handling tasks in the department. The environment is hot, dusty, and in continuous operation, making isolation and safe access more complex than in batch-process departments.

2 MAJOR EQUIPMENT

SINTER MACHINE (TRAVELLING GRATE)

Continuous loop of steel pallet cars carrying the sinter bed from the feed end through the ignition zone and combustion zone to the discharge end. Pallet cars, grate bars, side plates, and drive mechanisms require regular maintenance and component replacement.

WIND BOXES & EXHAUST DUCTS

Series of suction chambers below the travelling grate that draw combustion air downward through the sinter bed. Wind box inspection doors, sealing strips, and duct connections require manual access during operations and shutdown for inspection and repair.

COOLER (CIRCULAR OR LINEAR)

Cools the hot crushed sinter using forced air before it is screened and transferred to the blast furnace. Cooler pallets, grate bars, and drive components require maintenance similar to the main sinter machine — hot material, confined access, heavy components.

IGNITION HOOD

Gas-fired furnace structure at the feed end of the machine that ignites the surface of the raw mix. Burner assemblies, refractory lining, and gas supply pipework require periodic maintenance access — in a hot, enclosed structure above the moving grate.

SINTER CRUSHER (SINGLE ROLL CRUSHER)

Breaks the hot sinter cake at machine discharge into manageable lumps. Crusher teeth, liners, and the crusher frame experience rapid wear and require regular replacement — in a hot, abrasive environment immediately downstream of the sinter discharge point.

SCREENING & CONVEYOR SYSTEM

Vibrating screens classify cooled sinter into product sizes. The conveyor network transfers material between all process steps. Belt, idler, screen deck, and transfer chute maintenance follows the same pattern as the RMHP but in a hotter, dustier environment.

3 MANUAL TASKS & HAND EXPOSURE SCENARIOS

• HIGH · EXPOSURE FREQUENCY		
Pallet Car — Grate Bar Replacement		BURNS / CRUSH / ABRASION
WHY THE HAND IS THERE Worn or broken grate bars must be manually removed from the pallet car body and replaced. Bars are heavy, retain residual heat from the sintering process, and must be lifted, positioned, and seated by hand in the confined space of the pallet car body. <i>"When a grate bar is removed from a pallet car, what is the method for extracting the bar — and where does the worker's hand sit relative to the bar body during extraction and replacement?"</i>	HAND INTERFACE Grate bar body (hot cast iron or alloy), pallet car side wall, bar seating ledge, removal tool handle	EXPOSURE TYPE Burns from residual heat on bar surface; hand crushed between bar and pallet body during positioning; abrasion on rough cast surfaces
ENGINEERING INTERFACE CONSIDERATION Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.		

• HIGH · EXPOSURE FREQUENCY		
Pallet Car — Side Plate Removal & Refitting		CRUSH / IMPACT
WHY THE HAND IS THERE Side plates on pallet cars form the lateral walls of the sinter bed. Worn side plates are removed and replaced using bars, hammers, and manual lifting. The plate must be guided into its mounting slots by hand while a second worker applies driving force. <i>"During side plate insertion, which hand is on the plate and which is on the driving tool — and what happens to the holding hand when the driving blow lands?"</i>	HAND INTERFACE Side plate body and edge, mounting slot face, driving bar handle, pallet car frame	EXPOSURE TYPE Hand crushed between side plate and car frame during insertion; struck-by from hammer slip during driving; pinch between plate edge and slot entry
ENGINEERING INTERFACE CONSIDERATION Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.		

3

MANUAL TASKS & HAND EXPOSURE SCENARIOS — CONTINUED

• HIGH • EXPOSURE FREQUENCY		
Sinter Crusher — Tooth & Liner Replacement		
CRUSH / BURNS / ABRASION		
WHY THE HAND IS THERE	HAND INTERFACE	EXPOSURE TYPE
Crusher teeth and liners on the single-roll or multi-roll sinter crusher wear rapidly due to the abrasive, hot sinter material. Replacement requires manual handling of heavy tooth assemblies inside the crusher housing, which retains heat from recent operation.	Crusher tooth body and mounting face, liner plate, crusher housing interior, retaining bolt	Hand crushed between tooth and housing during positioning; burns from residual heat on crusher interior surfaces; abrasion on worn tooth edges
<i>"When the sinter crusher is opened for tooth replacement, what method is used to position the new tooth in its mounting — and where are the worker's hands relative to the housing walls during that moment?"</i>		
ENGINEERING INTERFACE CONSIDERATION		
Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.		

• HIGH • EXPOSURE FREQUENCY

Wind Box — Inspection Door & Sealing Strip Maintenance

BURNS / PINCH / ABRASION

WHY THE HAND IS THERE	HAND INTERFACE	EXPOSURE TYPE
Wind box inspection doors are opened during operations to check for blockages and air flow issues. Sealing strips between wind boxes and pallet car side plates wear and must be replaced manually. Both tasks involve hand contact with hot, dusty metal surfaces in confined spaces below the machine.	Inspection door handle and frame (hot), sealing strip body, wind box structure, fastening bolts	Burns from hot door and frame surfaces; pinch between sealing strip and wind box body during fitting; abrasion from rough internal surfaces

"When a wind box inspection door is opened during machine operation, what is the clearance between the worker's hand and the hot pallet car running above the wind box?"

ENGINEERING INTERFACE CONSIDERATION

Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.

• MEDIUM • EXPOSURE FREQUENCY

Ignition Hood — Burner Assembly & Refractory Maintenance

BURNS / CRUSH

WHY THE HAND IS THERE	HAND INTERFACE	EXPOSURE TYPE
Burner assemblies in the ignition hood require periodic replacement and adjustment. Refractory lining inside the hood is repaired during short shutdown windows. Workers reach into the hood structure to position burner components and handle refractory bricks — in residual heat from recent operation.	Burner nozzle and body, gas supply coupling, refractory brick face and edge, hood structure inner frame	Burns from residual heat in hood interior; hand crushed between burner body and mounting frame during installation; abrasion on refractory edges

"When burner assemblies are replaced in the ignition hood, what is the method used to position the burner body in its mounting — and what holds it in position while the fixing bolts are engaged?"

ENGINEERING INTERFACE CONSIDERATION

Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.

• HIGH • EXPOSURE FREQUENCY		
Return Fines & Sinter Discharge — Chute Blockage Clearing		LINE-OF-FIRE / BURNS / STRUCK-BY
WHY THE HAND IS THERE Hot sinter and return fines block chutes and transfer points frequently due to the irregular, hot, and sticky nature of the material. Workers insert bars or rods — or their arms — through inspection openings to clear blockages, often while the downstream conveyor or screen is still running.	HAND INTERFACE Chute opening edge (hot), clearing bar handle, material face, feeder or screen below the opening	EXPOSURE TYPE Burns from hot material surge when blockage releases; hand struck by material; hand caught on screen or feeder below the opening
<i>"When a sinter chute blocks, what is the procedure for clearing it — and how long does the crew wait before initiating manual clearing after automated attempts fail?"</i>		
ENGINEERING INTERFACE CONSIDERATION Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.		

• MEDIUM • EXPOSURE FREQUENCY		
Cooler Pallet — Grate Bar & Drive Chain Maintenance		CRUSH / BURNS
WHY THE HAND IS THERE	HAND INTERFACE	EXPOSURE TYPE
Cooler pallet grate bars and drive chain components wear and require replacement. The cooler environment is hot, and access to chain and sprocket components requires the hand to be positioned near large-pitch chain links, sprocket teeth, and drive shaft interfaces.	Chain link and pin, sprocket tooth face, grate bar body, drive shaft coupling, cooler pallet car frame	Hand crushed between chain and sprocket during link insertion; burns from hot grate bars; caught-between risk at drive shaft coupling
<i>"When chain link pins are inserted or removed in the cooler drive system, what keeps the chain section held open — and where are the worker's hands relative to the sprocket teeth during that operation?"</i>		
ENGINEERING INTERFACE CONSIDERATION		
Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.		

• HIGH · EXPOSURE FREQUENCY

Screen Deck Replacement — Hot Sinter Screening Section

CRUSH / ABRASION / BURNS

WHY THE HAND IS THERE	HAND INTERFACE	EXPOSURE TYPE
Screen panels and decks in the hot and cold sinter screening sections wear rapidly and require regular replacement. Panels are heavy and must be lowered through the screen body with limited access clearance — in an elevated-temperature environment.	Screen panel edges (wire mesh or cast), tensioning bar, retaining bolt, screen body inner frame	Hand crushed between panel and frame during positioning; abrasion on wire mesh edges contaminated with hot sinter fines; pinch under tensioning bar

"How many screen decks are replaced per shift or per week in the hot screening section — and has the hand position required during panel installation ever been formally reviewed?"

ENGINEERING INTERFACE CONSIDERATION

Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.

• MEDIUM · EXPOSURE FREQUENCY

Raw Mix Conveyor — Idler & Belt Maintenance

CAUGHT-BETWEEN / PINCH

WHY THE HAND IS THERE	HAND INTERFACE	EXPOSURE TYPE
Belt conveyors transporting raw sinter mix — fine, moist, and sticky — block idlers and scrapers more frequently than dry bulk conveyors. Idler replacement and scraper blade adjustment in this section follows the same pattern as the RMHP but with the added risk of wet, sticky material interfering with grip and tool control.	Conveyor belt underside (wet and sticky), idler roller shell, idler frame bracket, belt lifting device	Hand caught between belt and roller during re-tensioning; finger trapped in idler bracket; grip failure due to wet material on belt surface

"In the raw mix conveyor section, where belt material is wet and sticky, how does the crew manage grip on the belt during idler change compared to the dry sinter conveyor section?"

ENGINEERING INTERFACE CONSIDERATION

Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.

• MEDIUM • EXPOSURE FREQUENCY		
Sinter Machine Drive — Chain, Sprocket & Drive Shaft Maintenance		CAUGHT-BETWEEN / CRUSH
WHY THE HAND IS THERE The travelling grate is driven by large-pitch roller chains, sprockets, and drive shafts at each end of the machine. Chain link replacement, sprocket tooth inspection, and drive shaft coupling maintenance require the hand to be positioned between large chain and sprocket components during assembly and disassembly.	HAND INTERFACE Chain link and side plate, sprocket tooth, drive shaft coupling flange, bearing housing, retaining pin	EXPOSURE TYPE Hand caught between chain and sprocket during link engagement; crush between coupling flange and bearing housing during shaft alignment
<i>"When drive chain maintenance is carried out on the sinter machine, how is the chain held in a fixed position while pins are removed — and who controls that position?"</i>		
ENGINEERING INTERFACE CONSIDERATION Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.		

4 SHUTDOWN & OVERHAUL — ADDITIONAL EXPOSURE

Note: LOW exposure frequency refers to how often the hand is exposed during normal operations, not to the consequence if contact occurs. Shutdown tasks often carry higher consequence per event.

TASK	HAND EXPOSURE	FREQ.	EXPOSURE	PSC ENGINEERING INTERFACE PORTFOLIO
Complete pallet car rebuild (grate bars, side plates, wheels)	All pallet car components removed and replaced; heavy cast components handled manually throughout campaign	LOW	BURNS / CRUSH	PSC Manual Lifting Interfaces · PSC Position & Reach Interfaces · PSC Striking & Alignment Interfaces

TASK	HAND EXPOSURE	FREQ.	EXPOSURE	PSC ENGINEERING INTERFACE PORTFOLIO
Sinter machine frame & structural repair	Structural sections lifted by crane and guided manually onto machine frame for welding and bolting	LOW	CRUSH	PSC Load Control Interfaces · PSC Position & Reach Interfaces

TASK	HAND EXPOSURE	FREQ.	EXPOSURE	PSC ENGINEERING INTERFACE PORTFOLIO
Wind box replacement	Wind box sections (200–500 kg) lifted by crane; hand guidance during landing and bolting to duct structure	LOW	CRUSH	PSC Load Control Interfaces · PSC Position & Reach Interfaces

TASK	HAND EXPOSURE	FREQ.	EXPOSURE	PSC ENGINEERING INTERFACE PORTFOLIO
Ignition hood refractory relining	Refractory bricks handled individually inside confined hood structure; manual mortar application	LOW	BURNS / ABRASION	PSC Manual Lifting Interfaces · PSC Striking & Alignment Interfaces

5 CONTRACTOR & MOBILE EQUIPMENT INTERFACES

ACTIVITY / EQUIPMENT	HAND EXPOSURE SCENARIO	EXPOSURE	PSC ENGINEERING INTERFACE PORTFOLIO
Pallet car rebuild contractor	Grate bar, side plate, and wheel replacement across large numbers of pallet cars during the shutdown campaign; repetitive heavy component handling	BURNS CRUSH	PSC Magnetic Handling Interfaces · PSC Manual Lifting Interfaces · PSC Position & Reach Interfaces · PSC Striking & Alignment Interfaces

ACTIVITY / EQUIPMENT	HAND EXPOSURE SCENARIO	EXPOSURE	PSC ENGINEERING INTERFACE PORTFOLIO
Rigging crew (structural components)	Slings and guiding wind box sections, drive shaft components, and structural steel during crane lifts throughout shutdown	LINE-OF-FIRE	PSC Load Control Interfaces

ACTIVITY / EQUIPMENT	HAND EXPOSURE SCENARIO	EXPOSURE	PSC ENGINEERING INTERFACE PORTFOLIO
Mobile crane (shutdown lifts)	Hand guidance of wind boxes, pallet car assemblies, and drive components during crane landing on machine structure	CRUSH	PSC Load Control Interfaces · PSC Position & Reach Interfaces

5

CONTRACTOR & MOBILE EQUIPMENT INTERFACES — CONTINUED

ACTIVITY / EQUIPMENT	HAND EXPOSURE SCENARIO	EXPOSURE	PSC ENGINEERING INTERFACE PORTFOLIO
Refractory contractor	Ignition hood brick laying and castable application; individual brick and castable panel handling in confined hot structure	BURNS ABRASION	PSC Manual Lifting Interfaces · PSC Striking & Alignment Interfaces

6

SINTER PLANT QUICK ASSESSMENT CHECKLIST

Use during a plant walkdown or shutdown planning session. Answer based on current observed practice.

- ☐ Are pallet car grate bars extracted and inserted with the worker's hand in direct contact with the hot bar surface?
- ☐ During side plate installation, is a holding hand positioned on the plate while another worker drives it into the slot?
- ☐ Are sinter chute blockages cleared by inserting rods or arms through inspection openings while the downstream conveyor is running?
- ☐ Are crusher tooth replacements carried out with the worker's hand inside the crusher housing during bolt alignment?
- ☐ Are chain link pins inserted or removed in the sinter machine drive system with the worker's hand between chain and sprocket?
- ☐ Are screen deck panel replacements in the hot sinter section carried out without a magnetic or mechanical positioning interface?
- ☐ Are wind box crane lifts during shutdown controlled with anti-tangle taglines throughout the full landing sequence?
- ☐ During ignition hood burner replacement, does the worker's hand contact the burner body or hood structure directly to position it?

If you answered **Yes** to any of the above, PSC can review those tasks and recommend representative hands-free engineered interfaces to consider. Contact Shivani at **+91-96031-66448** or **sales@pschandsafety.com**

7 PSC ENGINEERING INTERFACE PORTFOLIO — SINTER PLANT

Representative PSC interfaces to consider for the hand exposure scenarios identified in this chapter. Contact PSC for the full range and engineering guidance specific to your application and site conditions.

LOAD CONTROL INTERFACES

INTERFACE	PRIMARY SINTER PLANT APPLICATION	REP. SIZES	PART NUMBERS	SCENARIOS
PSC Load Control Interfaces	Controlling suspended wind box sections, structural components, and drive assemblies during shutdown crane lifts	20 ft, 25 ft	PSC Load Control Interfaces	Shutdown · Contractor

INTERFACE	PRIMARY SINTER PLANT APPLICATION	REP. SIZES	PART NUMBERS	SCENARIOS
PSC Load Control Interfaces	Attaching and retrieving taglines on structural and machine components without entering the suspended load zone	10 m, 15 m	PSC Load Control Interfaces	Contractor

POSITION & REACH INTERFACES

INTERFACE	PRIMARY SINTER PLANT APPLICATION	REP. SIZES	PART NUMBERS	SCENARIOS
PSC Load Control Interfaces · PSC Position & Reach Interfaces	Guiding structural components during crane landing; sinter chute blockage clearing at extended reach; wind box positioning during shutdown	50", 72", 96"	PSC Position & Reach Interfaces	6 · Shutdown

INTERFACE	PRIMARY SINTER PLANT APPLICATION	REP. SIZES	PART NUMBERS	SCENARIOS
Guide-It® Push/Pull Pole	Heavy-duty nylon head; guiding and spotting suspended wind box and machine components during shutdown crane lifts	50", 72"	PSC Position & Reach Interfaces	Shutdown · Contractor

INTERFACE	PRIMARY SINTER PLANT APPLICATION	REP. SIZES	PART NUMBERS	SCENARIOS
PSC Load-It® Push Pull Tool	Wind box inspection door operation; sealing strip positioning; conveyor belt manipulation during idler change in raw mix section	4 ft, 6 ft	PSC Position & Reach Interfaces	4 · 9 · 10

INTERFACE	PRIMARY SINTER PLANT APPLICATION	REP. SIZES	PART NUMBERS	SCENARIOS
3P Xtend Tool	Extended-reach sinter chute blockage clearing; reach into confined wind box openings without entering the hazard zone; extends to 12 ft	6 ft / 12 ft extended	PSC Load Control Interfaces	6

INTERFACE	PRIMARY SINTER PLANT APPLICATION	REP. SIZES	PART NUMBERS	SCENARIOS
PSC SafeGuider Tool	Wind box inspection door operation at standoff; tagline retrieval near hot machine surfaces; dielectric hardwood construction	3 ft, 4 ft, 6 ft	PSC Position & Reach Interfaces	4

MAGNETIC HANDLING INTERFACES

7 PSC ENGINEERING INTERFACE PORTFOLIO — SINTER PLANT — CONTINUED

INTERFACE	PRIMARY SINTER PLANT APPLICATION	REP. SIZES	PART NUMBERS	SCENARIOS
PSC Load-It® Mag (Non-Extendable · 500 lbs)	Positioning ferrous grate bars, side plates, crusher liners, and screen panels — may reduce direct hand contact on heavy hot ferrous surfaces where compatible with component geometry	4 ft, 6 ft	PSC Magnetic Handling Interfaces · PSC Position & Reach Interfaces	1·2·3·8

INTERFACE	PRIMARY SINTER PLANT APPLICATION	REP. SIZES	PART NUMBERS	SCENARIOS
PSC Load-It® Mag Extendable (275 lbs)	Reach-in positioning of ferrous components in confined crusher housings and screen bodies where fixed-length tools may not access	4 to 8 ft adjustable	PSC Position & Reach Interfaces	3 · 8

STRIKE & ALIGN INTERFACES

INTERFACE	PRIMARY SINTER PLANT APPLICATION	REP. SIZES	PART NUMBERS	SCENARIOS
PSC Striking & Alignment Interfaces	Holding side plate driving bars, chain link pins, crusher tooth retaining bolts, and fasteners during hammer-driven assembly across the sinter plant	295 mm, 375 mm, 850 mm	PSC Striking & Alignment Interfaces	2·3·4·7·10

INTERFACE	PRIMARY SINTER PLANT APPLICATION	REP. SIZES	PART NUMBERS	SCENARIOS
PSC Chisel & Punch Holder	Chisel work during refractory removal in ignition hood and wind box repairs; removes holding hand from strike zone	Fits chisels to 1" dia.	PSC Striking & Alignment Interfaces	5 · Shutdown

INTERFACE	PRIMARY SINTER PLANT APPLICATION	REP. SIZES	PART NUMBERS	SCENARIOS
PSC RiggerMate® Hook	Positioning sling eyes and rigging chain hooks during machine component and structural crane lifts without direct hand contact on rigging	Single size	PSC Load Control Interfaces	Contractor

MANUAL HANDLING INTERFACES

INTERFACE	PRIMARY SINTER PLANT APPLICATION	REP. SIZES	PART NUMBERS	SCENARIOS
PSC Lift Assist® Single Handle	Carrying individual grate bars, side plates, burner components, and refractory bricks without direct grip on hot or abrasive component edges	50 mm × 900 mm	PSC Manual Lifting Interfaces	1·5·Shutdown

INTERFACE	PRIMARY SINTER PLANT APPLICATION	REP. SIZES	PART NUMBERS	SCENARIOS
PSC Lift Assist® Double Handle	Two-person carrying of heavier screen panels, structural plates, and machine components during campaign and shutdown	50 mm × 1500 mm	PSC Manual Lifting Interfaces	8 · Shutdown

— APPLICATION-SPECIFIC ENGINEERING GUIDANCE

If any hand exposure scenario in this chapter reflects tasks in your plant, PSC Hand Safety India can provide a engineering guidance indication for representative interfaces to consider. A engineering guidance is a starting point for evaluating whether an engineered interface is worth pursuing — it is not a binding commitment.

INFORMATION TO PROVIDE

1. Department / plant area (e.g. Sinter Plant — Pallet Car)
2. Specific task or hand exposure scenario
3. Component weight and approximate dimensions
4. Whether the component is ferrous (magnetic interface applicable)
5. Residual heat level at the time of task (hot / warm / ambient)
6. Indicative quantity of interfaces required
7. Plant name and location

WHAT PSC PROVIDES

- Recommended interface and size for the task
- Indicative unit price (budgetary, not binding)
- Delivery lead time from Visakhapatnam
- Application notes for the specific scenario
- Trial order option for field evaluation
- Reference to comparable applications in similar plants

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Chapter 3 of 22 · Version 2

ENGINEER THE HAND OUT OF THE HAZARD™

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Pellet Plant

This chapter identifies typical manual hand exposure scenarios encountered in this department of an integrated steel plant and highlights representative PSC application solutions commonly used for similar industrial tasks. Final product selection should always consider the specific task, component geometry, operating environment and site risk assessment.

1 DEPARTMENT OVERVIEW

Facilitator opening: Ask the audience whether their pellet plant and their sinter plant are treated as equivalent departments from a hand safety standpoint — or whether one receives more systematic attention than the other. In most integrated plants, the pellet plant receives less structured safety analysis than the sinter machine, despite sharing many of the same mechanical interfaces and adding its own distinct set of high-temperature and rotating equipment hazards. That asymmetry is a useful starting point.

The Pellet Plant converts fine iron ore concentrate — material too fine for direct blast furnace charging — into spherical pellets of controlled size and strength that can be used as blast furnace feed, either alone or blended with sinter. Iron ore fines are mixed with a binder, typically bentonite, and formed into green balls on rotating disc pelletisers or drum pelletisers. The green balls are then indurated — hardened by high-temperature firing — on a travelling grate, or in a combination of a travelling grate and a rotary kiln, depending on the technology installed. After induration, the fired pellets are cooled, screened, and transferred to the blast furnace stockyard or to a storage facility for despatch.

From a hand safety perspective, the pellet plant presents three overlapping exposure environments. The green balling section involves rotating disc equipment with pinch and entanglement hazards. The induration section combines high-temperature equipment, travelling grate pallet cars, and burner systems similar to those in the sinter plant. The cooling and screening section mirrors the downstream sinter plant — hot material, vibrating screens, conveyor systems, and transfer chutes. Each of these sections has distinct hand exposure scenarios that are addressed in this chapter.

2 MAJOR EQUIPMENT

DISC PELLETISER (BALLING DISC)

Large rotating inclined disc on which iron ore fines and binder are rolled into spherical green balls. The disc rim, scraper assembly, feed chute, and disc support structure are maintenance access points with entanglement and pinch hazards from the rotating disc.

TRAVELLING GRATE (INDURATION MACHINE)

Continuous loop of pallet cars carrying green balls through drying, firing, and initial cooling zones. Pallet cars, grate bars, side plates, and drive components require maintenance identical in character to the sinter machine — with the added complication of grate bar geometry suited to pellet retention.

ANNULAR COOLER / CIRCULAR COOLER

Cools fired pellets using forced air before they enter the screening section. Cooler pallet cars, grate bars, side wall panels, and drive mechanisms require the same maintenance approach as the sinter cooler — hot material, confined access, heavy components.

ROLLER SCREEN (GREEN BALL SCREEN)

Classifies green balls by size before induration. Rollers are closely spaced and rotate continuously. Workers access the roller screen for roller replacement, blockage clearing, and feed adjustment — with hands near the rotating roller nip.

ROTARY KILN (WHERE INSTALLED)

Large rotating cylinder lined with refractory in which pellets are fired at elevated temperature. Kiln shell, trunnion rings, riding rings, support rollers, and drive gear require periodic inspection and maintenance — with hand exposure at coupling, roller adjustment, and shell access points.

SCREENING & CONVEYOR SYSTEM

Vibrating screens classify pellets into product, oversize, and return fines streams. The conveyor network connects all process steps. Belt, idler, screen deck, and transfer chute maintenance follows the same pattern as the sinter plant downstream section.

3 MANUAL TASKS & HAND EXPOSURE SCENARIOS

• HIGH · EXPOSURE FREQUENCY

Disc Pelletiser — Scraper Blade Adjustment & Replacement

PINCH / ENTANGLEMENT

WHY THE HAND IS THERE Scraper blades on the disc pelletiser prevent material build-up on the disc face. Blades must be adjusted for clearance and replaced when worn. The hand is positioned on or near the disc rim to gauge clearance, hold the blade during adjustment, or extract and insert blades — with the disc at reduced speed or stationary but in a position where restart risk exists.	HAND INTERFACE Scraper blade edge and body, disc rim surface, blade mounting bracket, disc face near material bed	EXPOSURE TYPE Pinch between blade and disc rim during adjustment; entanglement risk if hand contacts disc face during slow rotation; laceration on blade edge
--	--	--

"During scraper blade adjustment, is the disc fully isolated and locked out — or is adjustment carried out at reduced speed because the clearance can only be set dynamically?"

ENGINEERING INTERFACE CONSIDERATION

Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.

• HIGH · EXPOSURE FREQUENCY

Roller Screen — Roller Replacement & Blockage Clearing

PINCH / CAUGHT-BETWEEN

WHY THE HAND IS THERE Rollers on the green ball screening deck wear and must be replaced. Oversized balls or debris occasionally bridge between rollers, blocking the screen. Workers reach between or across the roller array to clear blockages or extract worn rollers — with closely spaced rollers presenting a severe pinch hazard.	HAND INTERFACE Roller shell and shaft end, inter-roller gap, roller mounting bracket, screen frame, material bridging between rollers	EXPOSURE TYPE Hand caught between rollers during blockage clearing; finger drawn into roller nip; hand pinched between roller shaft and mounting bracket during extraction
--	--	---

"When a blockage bridges between rollers on the green ball screen, what tool does the crew use to clear it — and at what point does a hand enter the inter-roller space?"

ENGINEERING INTERFACE CONSIDERATION

Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.

3

MANUAL TASKS & HAND EXPOSURE SCENARIOS — CONTINUED

• HIGH • EXPOSURE FREQUENCY		
Travelling Grate — Pallet Car Grate Bar & Side Plate Maintenance		BURNS / CRUSH / ABRASION
WHY THE HAND IS THERE As in the sinter plant, grate bars and side plates on the induration machine pallet cars wear and require periodic replacement. Components retain residual heat from the induration process and must be manually extracted, positioned, and seated in the confined space of the pallet car body.	HAND INTERFACE Grate bar body (hot cast iron or alloy), side plate face and edge, pallet car body, bar seating ledge	EXPOSURE TYPE Burns from residual heat on bar and plate surfaces; hand crushed between component and pallet car body during positioning; abrasion on rough cast surfaces
"On the induration machine, how does the crew distinguish between a grate bar that has cooled sufficiently for unprotected handling and one that has not — and what determines that judgement?"		
ENGINEERING INTERFACE CONSIDERATION Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.		

• MEDIUM · EXPOSURE FREQUENCY

Rotary Kiln — Support Roller & Riding Ring Inspection

PINCH / CRUSH

WHY THE HAND IS THERE	HAND INTERFACE	EXPOSURE TYPE
Support rollers and riding rings on the rotary kiln require periodic lubrication, alignment checks, and visual inspection during operation. Workers approach the rotating kiln shell and support roller to check contact, apply lubricant, or measure roller skew — with the kiln rotating continuously at slow speed.	Riding ring face (rotating), support roller shell, lubrication point, skew adjustment mechanism, kiln shell surface	Pinch between riding ring and support roller; hand drawn into the contact zone if grip is lost; crush between adjustment tool and roller frame

"When lubrication is applied to the support roller contact zone during kiln operation, what is the position of the worker's hand relative to the riding ring and roller interface?"

ENGINEERING INTERFACE CONSIDERATION

Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.

• MEDIUM · EXPOSURE FREQUENCY

Induration Machine — Burner & Hood Maintenance

BURNS / CRUSH

WHY THE HAND IS THERE	HAND INTERFACE	EXPOSURE TYPE
Burner assemblies in the drying, firing, and soaking hoods of the induration machine require periodic replacement and adjustment. Workers reach into the hood structure to position burner bodies, connect gas supply couplings, and apply fixing bolts — in an environment with residual heat from recent operation.	Burner nozzle body, gas coupling, hood refractory surface, fixing bolt, burner mounting frame	Burns from residual heat inside the hood structure; hand crushed between burner body and mounting frame during installation; abrasion on refractory edges

"When a burner is installed in the induration hood, what method is used to hold the burner in position during bolt engagement — and what prevents the holding hand from being between the burner body and the mounting frame?"

ENGINEERING INTERFACE CONSIDERATION

Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.

• HIGH • EXPOSURE FREQUENCY		
Pellet Chute & Transfer Point — Blockage Clearing		LINE-OF-FIRE / BURNS
WHY THE HAND IS THERE Fired pellets — hard, round, and hot immediately after cooling — block transfer chutes and screen feed points when bridging occurs. Workers insert bars or rods through inspection openings to clear blockages, often while downstream conveyors or screens continue to run.	HAND INTERFACE Chute opening edge (hot), clearing bar handle, pellet material face, screen or conveyor below the opening	EXPOSURE TYPE Hand struck by hot pellet surge when blockage releases; hand in line of fire at chute opening; burns from residual heat on chute walls
<i>"When a pellet transfer chute blocks, what is the sequence of steps before a worker physically approaches the inspection opening — and what determines when manual clearing begins?"</i>		
ENGINEERING INTERFACE CONSIDERATION Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.		

• MEDIUM · EXPOSURE FREQUENCY		
Cooler — Pallet Car Grate Bar & Drive Chain Maintenance		CRUSH / BURNS
WHY THE HAND IS THERE	HAND INTERFACE	EXPOSURE TYPE
Annular or circular cooler pallet car grate bars and drive chain components require the same maintenance approach as the sinter cooler. The hand is positioned near hot grate bars during extraction and replacement, and near chain-and-sprocket interfaces during drive maintenance.	Grate bar body, cooler pallet car frame, chain link and pin, sprocket tooth, drive shaft coupling	Hand crushed between grate bar and car frame; caught-between risk at chain and sprocket during link work; burns from residual heat on cooler components
<i>"In the pellet cooler, how is the drive chain held stationary during link pin removal — and where is the worker's hand relative to the sprocket during that operation?"</i>		
ENGINEERING INTERFACE CONSIDERATION		
Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.		

• MEDIUM • EXPOSURE FREQUENCY

Rotary Kiln — Refractory Lining Inspection & Patching

BURNS / ABRASION / CONFINED SPACE

WHY THE HAND IS THERE

Refractory bricks and castable lining inside the rotary kiln are inspected during cold shutdowns and patched where spalling or damage is observed. Workers enter or reach into the kiln interior, handling individual bricks and applying castable by hand in a confined cylindrical space.

HAND INTERFACE

Refractory brick face and edges, castable lining surface, kiln shell inner wall, patching tool handles

EXPOSURE TYPE

Abrasion and cuts on refractory edges; burns from inadequately cooled surfaces; hand trapped against kiln shell during brick handling in confined interior

"During kiln refractory patching, what method is used to carry individual bricks from the kiln entrance to the repair location — and what does the worker do with the brick when both hands are needed for mortar application?"

ENGINEERING INTERFACE CONSIDERATION

Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.

• HIGH • EXPOSURE FREQUENCY

Screen Deck Replacement — Product & Return Fines Screening

CRUSH / ABRASION

WHY THE HAND IS THERE

Screen panels on product and return fines screens wear due to the abrasive nature of fired pellets. Replacement requires manual positioning of heavy panels through the screen body with limited access clearance — the same scenario as in the sinter plant but with the harder, rounder surface of fired pellets adding a rolling/slip hazard to panel handling.

HAND INTERFACE

Screen panel edges and face, tensioning bar, retaining bolt, screen body inner frame

EXPOSURE TYPE

Hand crushed between panel and frame during positioning; abrasion on panel edges; pinch under tensioning bar during installation

"On the product screen, how is the replacement screen panel moved from the staging area to its installed position — and at what point during installation is the worker's hand inside the screen body?"

ENGINEERING INTERFACE CONSIDERATION

Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.

• MEDIUM • EXPOSURE FREQUENCY		
Binder Feed System — Mixer & Feed Screw Maintenance		PINCH / CAUGHT-BETWEEN
WHY THE HAND IS THERE The bentonite binder feed system includes mixers, screw conveyors, and feed hoppers that require regular cleaning, paddle replacement, and blockage clearing. Mixer paddles and screw flights are positioned close together and build up with sticky, moist bentonite that workers clear manually during brief shutdowns.	HAND INTERFACE Mixer paddle face and edge, screw flight edge, mixer housing interior, feed hopper opening	EXPOSURE TYPE Hand caught between mixer paddle and housing during cleaning; finger trapped in screw flight during clearing; pinch between paddle arm and shaft during paddle replacement
<i>"During mixer cleaning in the binder system, is the mixer fully isolated before any hand enters the mixer housing — or is cleaning done with the mixer inching or at rest but without full isolation?"</i>		
ENGINEERING INTERFACE CONSIDERATION Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.		

4 SHUTDOWN & OVERHAUL — ADDITIONAL EXPOSURE

LOW exposure frequency refers to how often the hand is exposed in normal operations, not to the consequence if contact occurs. Shutdown tasks in this department may carry high consequence due to component weight, residual heat, and confined access.

TASK	HAND EXPOSURE	FREQ.	EXPOSURE	PSC ENGINEERING INTERFACE PORTFOLIO
Full pallet car rebuild (grate bars, side plates, wheels)	All components removed and replaced; heavy cast components handled throughout the campaign in hot environment	LOW	BURNS / CRUSH	PSC Magnetic Handling Interfaces · PSC Manual Lifting Interfaces · PSC Position & Reach Interfaces · PSC Striking & Alignment Interfaces

TASK	HAND EXPOSURE	FREQ.	EXPOSURE	PSC ENGINEERING INTERFACE PORTFOLIO
Rotary kiln full refractory relining	Brick-by-brick lining of kiln interior; workers inside the kiln handling bricks and applying mortar in confined cylindrical space	LOW	BURNS / ABRASION	PSC Manual Lifting Interfaces · PSC Striking & Alignment Interfaces

TASK	HAND EXPOSURE	FREQ.	EXPOSURE	PSC ENGINEERING INTERFACE PORTFOLIO
Kiln support roller & riding ring replacement	Heavy roller assemblies and riding ring sections lifted by crane; hand guidance during alignment and bolting to support structure	LOW	CRUSH	PSC Load Control Interfaces · PSC Position & Reach Interfaces

TASK	HAND EXPOSURE	FREQ.	EXPOSURE	PSC ENGINEERING INTERFACE PORTFOLIO
Disc pelletiser liner & disc replacement	Wear liners inside the disc body are manually positioned and bolted; disc itself may be crane-lifted for replacement	LOW	CRUSH / PINCH	PSC Load Control Interfaces · PSC Position & Reach Interfaces · PSC Striking & Alignment Interfaces

5 CONTRACTOR & MOBILE EQUIPMENT INTERFACES

ACTIVITY / EQUIPMENT	HAND EXPOSURE SCENARIO	EXPOSURE	PSC ENGINEERING INTERFACE PORTFOLIO
Refractory contractor (kiln relining)	Full kiln brick relining campaign; individual bricks carried and positioned inside the kiln throughout the campaign	BURNS ABRASION	PSC Manual Lifting Interfaces · PSC Striking & Alignment Interfaces

ACTIVITY / EQUIPMENT	HAND EXPOSURE SCENARIO	EXPOSURE	PSC ENGINEERING INTERFACE PORTFOLIO
Pallet car rebuild contractor	Grate bar, side plate, and wheel replacement across the full pallet car fleet during shutdown; repetitive hot component handling	BURNS CRUSH	PSC Magnetic Handling Interfaces · PSC Manual Lifting Interfaces · PSC Position & Reach Interfaces · PSC Striking & Alignment Interfaces

5 CONTRACTOR & MOBILE EQUIPMENT INTERFACES — CONTINUED

ACTIVITY / EQUIPMENT	HAND EXPOSURE SCENARIO	EXPOSURE	PSC ENGINEERING INTERFACE PORTFOLIO
Rigging crew (kiln and machine components)	Slinging and guiding support rollers, riding ring sections, and structural components during crane maintenance lifts	LINE-OF-FIRE	PSC Load Control Interfaces
Mobile crane (shutdown lifts)	Hand guidance of kiln components, cooler parts, and structural elements during crane landing throughout shutdown	CRUSH	PSC Load Control Interfaces · PSC Position & Reach Interfaces

6 PELLET PLANT QUICK ASSESSMENT CHECKLIST

Use during a plant walkdown or shutdown planning session. Answer based on current observed practice.

- ☐ Is disc pelletiser scraper blade adjustment carried out with the disc running at reduced speed rather than under full isolation?
- ☐ When roller screen blockages are cleared, does a hand enter the inter-roller space before the rollers are confirmed stationary and isolated?
- ☐ Are induration machine grate bars handled directly without a mechanical or magnetic interface to carry the component?
- ☐ During rotary kiln support roller inspection, is the worker's hand positioned within the riding ring-roller contact zone?
- ☐ When pellet chute blockages are cleared, does a hand or arm enter the chute opening before the blockage is confirmed released?
- ☐ Are drive chain link pins inserted or removed in the cooler with the worker's hand near the sprocket tooth interface?
- ☐ During kiln refractory patching, are individual bricks carried by bare hand grip on the brick face and edges?
- ☐ Are kiln component crane lifts during shutdown controlled with anti-tangle taglines throughout the full landing sequence?

If you answered **Yes** to any of the above, PSC can review those tasks and recommend representative hands-free engineered interfaces to consider. Contact Shivani at **+91-96031-66448** or **sales@pschandsafety.com**

7 PSC ENGINEERING INTERFACE PORTFOLIO — PELLET PLANT

Representative PSC interfaces to consider for the hand exposure scenarios identified in this chapter. Contact PSC for the full range and engineering guidance specific to your application and site conditions.

LOAD CONTROL INTERFACES

INTERFACE	PRIMARY PELLET PLANT APPLICATION	REP. SIZES	PART NUMBERS	SCENARIOS
PSC Load Control Interfaces	Controlling suspended kiln components, support rollers, riding ring sections, and structural elements during shutdown crane lifts	20 ft, 25 ft	PSC Load Control Interfaces	Shutdown · Contractor

INTERFACE	PRIMARY PELLET PLANT APPLICATION	REP. SIZES	PART NUMBERS	SCENARIOS
PSC Load Control Interfaces	Attaching and retrieving taglines on kiln and machine components without entering the suspended load zone	10 m, 15 m	PSC Load Control Interfaces	Contractor

POSITION & REACH INTERFACES

INTERFACE	PRIMARY PELLET PLANT APPLICATION	REP. SIZES	PART NUMBERS	SCENARIOS
PSC Load Control Interfaces · PSC Position & Reach Interfaces	Pellet chute blockage clearing at extended reach; guiding kiln components during crane landing; kiln roller inspection standoff; structural component guidance during shutdown	42", 50", 72", 96"	PSC Position & Reach Interfaces	4-6-Shutdown

INTERFACE	PRIMARY PELLET PLANT APPLICATION	REP. SIZES	PART NUMBERS	SCENARIOS
Guide-It® Push/Pull Pole	Guiding and spotting suspended kiln and machine components during shutdown crane lifts	50", 72"	PSC Position & Reach Interfaces	Shutdown · Contractor

INTERFACE	PRIMARY PELLET PLANT APPLICATION	REP. SIZES	PART NUMBERS	SCENARIOS
PSC Load-It® Push Pull Tool	Disc scraper blade adjustment and positioning; roller screen blockage clearing; binder mixer reach-in clearing; burner installation assistance	4 ft, 6 ft	PSC Position & Reach Interfaces	1-2-5-10

INTERFACE	PRIMARY PELLET PLANT APPLICATION	REP. SIZES	PART NUMBERS	SCENARIOS
3P Xtend Tool	Extended-reach pellet chute and binder mixer blockage clearing without entering the hazard zone; extends to 12 ft	6 ft / 12 ft extended	PSC Load Control Interfaces	6 · 10

INTERFACE	PRIMARY PELLET PLANT APPLICATION	REP. SIZES	PART NUMBERS	SCENARIOS
PSC SafeGuider Tool	Disc scraper clearance gauging at standoff; kiln roller inspection from safe distance; tagline retrieval near hot machine surfaces	3 ft, 4 ft	PSC Position & Reach Interfaces	1 · 4

MAGNETIC HANDLING INTERFACES

7 PSC ENGINEERING INTERFACE PORTFOLIO — PELLET PLANT — CONTINUED

INTERFACE	PRIMARY PELLET PLANT APPLICATION	REP. SIZES	PART NUMBERS	SCENARIOS
PSC Load-It® Mag (Non-Extendable · 500 lbs)	Positioning ferrous grate bars, side plates, disc wear liners, and screen panels — may reduce direct hand contact on heavy hot ferrous surfaces where compatible with component geometry	4 ft, 6 ft	PSC Magnetic Handling Interfaces · PSC Position & Reach Interfaces	3-9-Shutdown

INTERFACE	PRIMARY PELLET PLANT APPLICATION	REP. SIZES	PART NUMBERS	SCENARIOS
PSC Load-It® Mag Extendable (275 lbs)	Reach-in magnetic positioning of ferrous components in confined machine housings and screen bodies	4 to 8 ft adjustable	PSC Position & Reach Interfaces	9 · Shutdown

STRIKE & ALIGN INTERFACES

INTERFACE	PRIMARY PELLET PLANT APPLICATION	REP. SIZES	PART NUMBERS	SCENARIOS
PSC Striking & Alignment Interfaces	Holding bolts, pins, and fasteners during hammer-driven assembly across disc, grate bar, side plate, and cooler drive chain maintenance	295 mm, 375 mm, 850 mm	PSC Striking & Alignment Interfaces	1-3-7-Shutdown

INTERFACE	PRIMARY PELLET PLANT APPLICATION	REP. SIZES	PART NUMBERS	SCENARIOS
PSC Chisel & Punch Holder	Chisel work during kiln refractory removal and patching; removes holding hand from strike zone in confined kiln interior	Fits chisels to 1" dia.	PSC Striking & Alignment Interfaces	8 · Contractor

INTERFACE	PRIMARY PELLET PLANT APPLICATION	REP. SIZES	PART NUMBERS	SCENARIOS
PSC RiggerMate® Hook	Positioning sling eyes and chain hooks during kiln and machine component crane lifts without direct hand contact on rigging	Single size	PSC Load Control Interfaces	Contractor

MANUAL HANDLING INTERFACES

INTERFACE	PRIMARY PELLET PLANT APPLICATION	REP. SIZES	PART NUMBERS	SCENARIOS
PSC Lift Assist® Single Handle	Carrying individual grate bars, refractory bricks, burner components, and small maintenance parts without direct grip on hot or abrasive edges	50 mm × 900 mm	PSC Manual Lifting Interfaces	3-5-8-Contractor

INTERFACE	PRIMARY PELLET PLANT APPLICATION	REP. SIZES	PART NUMBERS	SCENARIOS
PSC Lift Assist® Double Handle	Two-person carrying of heavier screen panels, pallet car components, and kiln internals during campaign and shutdown	50 mm × 1500 mm	PSC Manual Lifting Interfaces	8 · 9 · Shutdown

— APPLICATION-SPECIFIC ENGINEERING GUIDANCE

If any hand exposure scenario in this chapter reflects tasks in your plant, PSC Hand Safety India can provide a engineering guidance indication for representative interfaces to consider. A engineering guidance is a starting point for evaluating whether an engineered interface is worth pursuing — it is not a binding commitment.

INFORMATION TO PROVIDE

1. Department / plant area (e.g. Pellet Plant — Roller Screen)
2. Specific task or hand exposure scenario
3. Component weight and approximate dimensions
4. Whether the component is ferrous (magnetic interface applicable)
5. Residual heat level at the time of task (hot / warm / ambient)
6. Indicative quantity of interfaces required
7. Plant name and location

WHAT PSC PROVIDES

- Recommended interface and size for the task
- Indicative unit price (budgetary, not binding)
- Delivery lead time from Visakhapatnam
- Application notes for the specific scenario
- Trial order option for field evaluation
- Reference to comparable applications in similar plants

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Chapter 4 of 22 · Version 2

ENGINEER THE HAND OUT OF THE HAZARD™

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A PSC Hand Safety Brand

Blast Furnace

This chapter identifies typical manual hand exposure scenarios encountered in this department of an integrated steel plant and highlights representative PSC application solutions commonly used for similar industrial tasks. Final product selection should always consider the specific task, component geometry, operating environment and site risk assessment.

1 DEPARTMENT OVERVIEW

Facilitator opening: Ask the audience when they last reviewed hand exposure specifically at the cast house floor — not at the furnace top, not in the stockhouse, but at the taphole and in the trough area during an active cast. In most plants this is the highest-consequence hand exposure point in the entire ironmaking process, and it is also one of the least frequently reviewed at the task level. That is the starting point for this chapter.

The Blast Furnace converts iron ore burden — a mix of sinter, pellets, and lump ore — along with coke and limestone flux, into liquid hot metal and slag. The furnace operates continuously, producing hot metal in a series of casts that occur every four to six hours depending on furnace size. The liquid hot metal is tapped from the taphole into troughs, runners, and torpedo ladles for transfer to the steel melt shop. Slag is tapped separately and either granulated or processed for other uses.

From a hand safety perspective, the blast furnace presents some of the most severe exposure conditions in the integrated steel plant. The cast house floor combines extreme radiant heat, flowing liquid metal at very high temperature, heavy mobile equipment — torpedo cars, tilting ladles — and the manual handling demands of taphole maintenance, trough repair, and ladle preparation. The stockhouse and furnace top add conveyor, skip, and bell-less top maintenance hazards. The stove complex adds valve, burner, and high-pressure piping maintenance. Each zone is addressed in this chapter.

2 MAJOR EQUIPMENT

CAST HOUSE — TAPHOLE, MUD GUN & DRILL

The taphole is the opening through which liquid hot metal and slag are tapped from the furnace. It is opened by the taphole drill and closed by the mud gun, which forces taphole clay into the opening. Workers interact with the taphole area for trough maintenance, mud gun nozzle changes, and emergency interventions during casting.

TORPEDO LADLE & LADLE TRANSFER CAR

Torpedo-shaped refractory-lined vessels on rail cars that receive and transport hot metal from the cast house to the steel melt shop. The ladle lid, coupling gear, and refractory lining require maintenance. Crane operations over filled and empty torpedoes create load control requirements at every transfer.

BELL-LESS TOP CHARGING SYSTEM

Rotating chute and hopper assembly at the furnace top that distributes burden material into the furnace. The chute, hopper, and sealing valve mechanisms require maintenance access at the furnace top — at significant height and in proximity to furnace gas and high-pressure systems.

CAST HOUSE — TROUGHS & RUNNERS

Refractory-lined channels that direct liquid hot metal and slag from the taphole to the torpedo ladle and slag pot. Trough linings wear with each cast and require frequent repair and periodic complete replacement — in a hot environment with mobile equipment operating overhead and alongside.

HOT BLAST STOVES

Large regenerative heat exchangers that preheat the blast air before it enters the furnace. Stove valves — hot blast, cold blast, combustion air, waste gas — are large, heavy mechanisms requiring manual operation and maintenance. Burner assemblies and refractory checkers also require periodic attention.

STOCKHOUSE & SKIP SYSTEM

Receiving, weighing, and conveying system for burden materials (sinter, pellets, coke) before charging. Skip cars, conveyor systems, screens, and weighing hoppers require the same maintenance approach as the RMHP — with the added constraint of operating in close proximity to the active furnace.

3

MANUAL TASKS & HAND EXPOSURE SCENARIOS

• HIGH · EXPOSURE FREQUENCY

Cast House — Trough & Runner Lining Repair

BURNS / CRUSH / ABRASION

WHY THE HAND IS THERE	HAND INTERFACE	EXPOSURE TYPE
Between casts, trough and runner linings are inspected and repaired manually — patching worn areas with castable refractory, repositioning displaced lining sections, and clearing skull buildup from the trough floor. Workers apply castable by hand, handle refractory components, and use bars and chisels to clear skull in an environment that retains significant heat from the previous cast.	Refractory castable and trowel, skull and solidified metal fragment, trough wall, chisel and clearing bar handle	Burns from residual heat in trough structure; hand struck by chisel slip during skull clearing; abrasion from refractory and skull material; crush between large skull fragment and trough wall
"Between casts, how much time is available for trough repair before the next taphole opening — and does that time pressure affect the sequence of tasks or the tools used?"		
ENGINEERING INTERFACE CONSIDERATION Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.		

• HIGH · EXPOSURE FREQUENCY

Cast House — Torpedo Ladle Hook & Crane Operations

LINE-OF-FIRE / CRUSH

WHY THE HAND IS THERE	HAND INTERFACE	EXPOSURE TYPE
Torpedo ladles are moved by overhead crane. Slings, hooks, and coupling gear must be positioned and released manually at the ladle trunnion and transfer car interfaces. Workers guide the torpedo ladle during crane operations at the tilting station and during emergency positioning — with mobile equipment and a filled hot metal vessel in close proximity.	Crane hook and sling at ladle trunnion, coupling latch on transfer car, torpedo ladle body and lid rim	Hand in line of fire of ladle movement during crane guidance; crush between ladle body and transfer car structure; hand struck if sling slips at trunnion
"During torpedo ladle crane operations at the cast house, what method is used to guide the ladle into position — and where does the guidance hand sit relative to the ladle movement path?"		
ENGINEERING INTERFACE CONSIDERATION Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.		

3

MANUAL TASKS & HAND EXPOSURE SCENARIOS — CONTINUED

• HIGH • EXPOSURE FREQUENCY		
Cast House — Mud Gun Nozzle Change & Alignment		BURNS / CRUSH / PINCH
WHY THE HAND IS THERE The mud gun nozzle wears with each taphole closure and requires periodic replacement. The nozzle is a heavy cast component that must be manually positioned onto the mud gun barrel and secured. The mud gun is positioned close to the taphole — in a zone that retains heat from the active cast.	HAND INTERFACE Nozzle body (hot cast iron), mud gun barrel end, retaining pin and clip, mud gun arm structure	EXPOSURE TYPE Burns from residual heat on nozzle and barrel; hand crushed between nozzle and barrel during fitting; pinch on retaining pin spring clip
<i>"When the mud gun nozzle is changed between casts, what is the method for holding the nozzle in position on the barrel while the retaining pin is engaged — and what does the holding hand contact during that moment?"</i>		
ENGINEERING INTERFACE CONSIDERATION Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.		

• MEDIUM • EXPOSURE FREQUENCY		
Slag Runner & Slag Pot — Positioning & Crane Operations		LINE-OF-FIRE / BURNS
WHY THE HAND IS THERE Slag pots are positioned under the slag runner by crane or transfer car to receive molten slag during casting. Workers guide the pot into position and signal the overhead crane. Slag runner maintenance between casts involves manual clearing of solidified slag from the runner channel.	HAND INTERFACE Crane hook and sling at slag pot, slag runner edge, solidified slag and clearing bar, transfer car coupling	EXPOSURE TYPE Hand in line of fire of pot movement during crane positioning; burns from hot slag runner surface; hand struck by solidified slag fragment during clearing
<i>"During slag pot positioning by crane at the cast house, what is the worker's position relative to the pot — and at what point does guidance involve hand contact with the pot or the crane rigging?"</i>		
ENGINEERING INTERFACE CONSIDERATION Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.		

• MEDIUM • EXPOSURE FREQUENCY		
Hot Blast Stove — Valve Maintenance & Burner Assembly		PINCH / BURNS / IMPACT
WHY THE HAND IS THERE Stove valves — large, heavy mechanisms controlling hot blast, cold blast, combustion air, and waste gas flows — require periodic maintenance of seating faces, spindles, and actuator mechanisms. Burner assemblies require nozzle replacement and refractory repair. Workers handle heavy valve components, position bolts, and hold parts during torquing in high-temperature areas.	HAND INTERFACE Valve disc or gate face, valve spindle, stud bolt and nut, burner nozzle body, refractory brick in dome or checker area	EXPOSURE TYPE Pinch between valve component and body during installation; burns from residual heat on valve and stove surfaces; impact from struck spanner on corroded fastener
<i>"When stove valve internals are removed and replaced, how are the heavy valve disc or gate components held in position during bolt engagement — and what contact does the worker's hand make with the valve body during that operation?"</i>		
ENGINEERING INTERFACE CONSIDERATION Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.		

• MEDIUM • EXPOSURE FREQUENCY		
Bell-less Top — Chute, Hopper & Seal Valve Maintenance		CRUSH / PINCH
WHY THE HAND IS THERE The rotating distribution chute, material hoppers, and sealing valves at the furnace top require periodic maintenance access. Workers reach into the hopper and valve housing to inspect sealing faces, replace wear liners, and adjust chute angles — at significant height above the furnace floor and near high-pressure sealing systems.	HAND INTERFACE Chute liner face and edge, hopper lining, seal valve disc face, actuator mechanism, mounting bolt	EXPOSURE TYPE Hand crushed between seal valve and seat during positioning; pinch on chute liner retaining bolt; hand trapped inside hopper if seal valve operates unexpectedly
<i>"During bell-less top chute liner replacement, what isolation is in place to prevent the distribution chute from rotating while hands are inside the hopper or near the chute arm?"</i>		
ENGINEERING INTERFACE CONSIDERATION Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.		

• HIGH · EXPOSURE FREQUENCY		
Stockhouse — Skip Car & Conveyor Maintenance		CAUGHT-BETWEEN / PINCH
WHY THE HAND IS THERE	HAND INTERFACE	EXPOSURE TYPE
Skip cars, conveyor belts, and weighing hoppers in the stockhouse require the same maintenance approach as the RMHP — idler replacement, belt work, blockage clearing — but in a more constrained space with higher production pressure due to the furnace's continuous demand for burden materials.	Skip car coupling, conveyor belt underside, idler frame bracket, hopper discharge gate mechanism	Hand caught between skip car and guide structure; caught-between at idler during belt work; pinch on hopper gate mechanism during clearing
<i>"In the stockhouse, when a conveyor belt is stopped for maintenance, what prevents the skip car or an adjacent conveyor from restarting while the maintenance crew is working?"</i>		
ENGINEERING INTERFACE CONSIDERATION		
Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.		

• LOW · EXPOSURE FREQUENCY

Cast House — Complete Trough Replacement

CRUSH / BURNS

WHY THE HAND IS THERE

Complete trough assemblies, when their lining life is exhausted, are replaced by crane lift. The trough — a large, heavy, hot refractory-lined structure — must be guided during crane landing onto the trough support structure in the cast house, where overhead clearance and access are limited. The task occurs infrequently but carries high consequence due to the component weight and the active cast house environment.

HAND INTERFACE

Trough body during crane guidance, crane hook and sling at trough lifting points, mounting bolt and support structure

EXPOSURE TYPE

Hand crushed between trough and support structure during landing; burns from residual heat on trough exterior; struck-by if sling shifts during crane approach

"During a complete trough change, what method is used to guide the trough into its mounting position — and how many workers are involved in that guidance, and where are they positioned?"

ENGINEERING INTERFACE CONSIDERATION

Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.

• MEDIUM · EXPOSURE FREQUENCY

Cooling Stave & Shell — Inspection & Leak Response

BURNS / LINE-OF-FIRE

WHY THE HAND IS THERE

Cooling staves embedded in the furnace shell circulate cooling water to protect the shell from heat. Stave connection points, water inlet and outlet fittings, and the shell around failed staves require manual inspection and intervention when a stave leak is detected. Workers reach to connection points on the furnace shell exterior where hot process gases may be present at access locations.

HAND INTERFACE

Stave connection fitting, pipe coupling, shell surface around stave (hot), isolation valve handle

EXPOSURE TYPE

Burns from hot furnace shell surface; hand in line of fire of hot gas or steam if stave connection is disturbed; crush between pipe and shell during fitting work

"When a cooling stave connection is accessed during furnace operation, what standoff procedure is in place — and does the procedure specify the tool used to manipulate the fitting, or only the protective equipment worn?"

ENGINEERING INTERFACE CONSIDERATION

Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.

• HIGH • EXPOSURE FREQUENCY

Gas Cleaning Plant — Valve, Pipe & Venturi Maintenance

PINCH / LINE-OF-FIRE

WHY THE HAND IS THERE	HAND INTERFACE	EXPOSURE TYPE
Blast furnace gas cleaning equipment — venturis, scrubbers, gas mains valves, and dust catchers — requires regular maintenance. Workers operate and maintain large valve mechanisms, position gaskets at flanges, and clear blockages in the gas main system. Blast furnace gas is toxic and pressurised, making every maintenance intervention in this area carry an additional hazard beyond the hand exposure itself.	Gas valve spindle and handwheel, flange bolt and gasket, venturi throat and body, gas main pipe end	Pinch between flange faces during gasket positioning; hand in line of fire of gas discharge if valve or flange is disturbed under pressure; impact from struck spanner on corroded bolt

"When gas main flanges are opened for maintenance in the gas cleaning plant, what confirms that the section is isolated and depressurised before any hand contacts the flange face?"

ENGINEERING INTERFACE CONSIDERATION

Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.

4 SHUTDOWN & OVERHAUL — ADDITIONAL EXPOSURE

LOW exposure frequency refers to how often the hand is exposed in normal operations, not to the consequence if contact occurs. Blast furnace reline and major overhaul tasks typically occur once every five to ten years but involve intensive hand exposure across a large contractor workforce over extended campaigns.

TASK	HAND EXPOSURE	FREQ.	EXPOSURE	PSC ENGINEERING INTERFACE PORTFOLIO
Blast furnace reline — refractory removal	Workers inside the furnace shell removing worn refractory by hand tool and mechanical equipment; confined space, hot residual surfaces	LOW	BURNS / ABRASION	PSC Manual Lifting Interfaces · PSC Striking & Alignment Interfaces

TASK	HAND EXPOSURE	FREQ.	EXPOSURE	PSC ENGINEERING INTERFACE PORTFOLIO
Blast furnace reline — brick laying	Individual refractory bricks handled and positioned by hand throughout the reline campaign; carried from staging area into the furnace interior	LOW	ABRASION / CRUSH	PSC Manual Lifting Interfaces · PSC Striking & Alignment Interfaces

TASK	HAND EXPOSURE	FREQ.	EXPOSURE	PSC ENGINEERING INTERFACE PORTFOLIO
Stove checker brick replacement	Checker bricks removed and replaced by hand inside the hot blast stove dome and checkerwork chamber	LOW	BURNS / ABRASION	PSC Manual Lifting Interfaces · PSC Striking & Alignment Interfaces

TASK	HAND EXPOSURE	FREQ.	EXPOSURE	PSC ENGINEERING INTERFACE PORTFOLIO
Torpedo ladle relining	Individual refractory bricks positioned by hand inside the torpedo ladle interior; mortar applied manually throughout the campaign	LOW	BURNS / ABRASION	PSC Manual Lifting Interfaces · PSC Striking & Alignment Interfaces

5 CONTRACTOR & MOBILE EQUIPMENT INTERFACES

ACTIVITY / EQUIPMENT	HAND EXPOSURE SCENARIO	EXPOSURE	PSC ENGINEERING INTERFACE PORTFOLIO
Refractory reline contractor	Full furnace brick lining campaign; large contractor workforce handling individual bricks inside the furnace shell throughout the reline	BURNS ABRASION	PSC Manual Lifting Interfaces · PSC Striking & Alignment Interfaces

ACTIVITY / EQUIPMENT	HAND EXPOSURE SCENARIO	EXPOSURE	PSC ENGINEERING INTERFACE PORTFOLIO
Rigging crew (cast house)	Slings and guiding trough assemblies, torpedo ladles, and stove components during crane maintenance lifts in the cast house	LINE-OF-FIRE	PSC Load Control Interfaces

5

CONTRACTOR & MOBILE EQUIPMENT INTERFACES — CONTINUED

ACTIVITY / EQUIPMENT	HAND EXPOSURE SCENARIO	EXPOSURE	PSC ENGINEERING INTERFACE PORTFOLIO
Torpedo ladle & transfer car (mobile)	Workers guiding torpedo car into position at tilting station; coupling and decoupling transfer car at ladle bay — hand near moving rail equipment	CRUSH	PSC Position & Reach Interfaces
Gas cleaning plant maintenance contractor	Valve and flange work in the BF gas cleaning circuit; gasket positioning, bolt alignment, and valve spindle work near gas-carrying pipework	PINCH LINE-OF-FIRE	PSC Position & Reach Interfaces · PSC Striking & Alignment Interfaces

6

BLAST FURNACE QUICK ASSESSMENT CHECKLIST

Use during a plant walkdown or shutdown planning session. Answer based on current observed practice.

- ☐ Are trough and runner repairs between casts carried out with chisels and bars held by hand in the strike zone?
- ☐ During torpedo ladle crane operations, are workers guiding the ladle by hand contact with the ladle body or rigging?
- ☐ Is the mud gun nozzle held by hand on the barrel while the retaining pin is driven in?
- ☐ During slag pot crane positioning at the cast house, does guidance involve direct hand contact with the pot or its rigging?
- ☐ Are stove valve components — discs, spindles, and retaining bolts — held by hand during hammer-driven assembly?
- ☐ During bell-less top maintenance, what isolation confirms the chute cannot rotate while hands are inside the hopper?
- ☐ When gas main flanges are opened in the gas cleaning plant, is the flange face accessible by hand before depressurisation is confirmed?
- ☐ During a complete trough crane change in the cast house, are anti-tangle taglines used throughout the full landing sequence?

If you answered **Yes** to any of the above, PSC can review those tasks and recommend representative hands-free engineered interfaces to consider. Contact Shivani at **+91-96031-66448** or **sales@pschandsafety.com**

7 PSC ENGINEERING INTERFACE PORTFOLIO — BLAST FURNACE

Representative PSC interfaces to consider for the hand exposure scenarios identified in this chapter. Contact PSC for the full range and engineering guidance specific to your application and site conditions.

LOAD CONTROL INTERFACES

INTERFACE	PRIMARY BF APPLICATION	REP. SIZES	PART NUMBERS	SCENARIOS
PSC Load Control Interfaces	Controlling torpedo ladles, trough assemblies, and stove components during crane operations throughout the cast house and shutdown	20 ft, 25 ft, 30 ft	PSC Load Control Interfaces	2-4-8-Contractor
PSC Load Control Interfaces	Attaching and retrieving taglines on trough assemblies and heavy cast house components without entering the suspended load zone	10 m, 15 m	PSC Load Control Interfaces	Contractor
PSC RiggerMate® Hook	Positioning sling eyes and crane hooks during torpedo ladle, slag pot, and trough crane lifts without direct hand contact on rigging	Single size	PSC Load Control Interfaces	2 · 4 · Contractor

POSITION & REACH INTERFACES

INTERFACE	PRIMARY BF APPLICATION	REP. SIZES	PART NUMBERS	SCENARIOS
PSC Load Control Interfaces · PSC Position & Reach Interfaces	Guiding torpedo ladles and trough assemblies during crane landing; cooling stove connection standoff; torpedo car positioning; trough replacement guidance	42", 50", 72"	PSC Position & Reach Interfaces	2-4-8-9
Guide-It® Push/Pull Pole	Guiding and spotting heavy cast house components — troughs, stove valves, ladle assemblies — during shutdown crane lifts	50", 72"	PSC Position & Reach Interfaces	4-8-Contractor
PSC SafeGuider Tool	Cooling stove connection standoff; gas valve operation at safe distance; tagline retrieval near hot cast house surfaces; dielectric hardwood	3 ft, 4 ft, 6 ft	PSC Position & Reach Interfaces	9
PSC Load-It® Push Pull Tool	Bell-less top liner positioning; skip and conveyor maintenance; gas main flange bolt alignment; stove valve component guidance	4 ft, 6 ft	PSC Position & Reach Interfaces	6-7-9-10

MAGNETIC HANDLING INTERFACES

7 PSC ENGINEERING INTERFACE PORTFOLIO — BLAST FURNACE — CONTINUED

INTERFACE	PRIMARY BF APPLICATION	REP. SIZES	PART NUMBERS	SCENARIOS
PSC Load-It® Mag (Non-Extendable · 500 lbs)	Positioning ferrous bell-less top chute liners, seal valve components, and structural items where compatible with component geometry and access	4 ft, 6 ft	PSC Magnetic Handling Interfaces · PSC Position & Reach Interfaces	6

STRIKE & ALIGN INTERFACES

INTERFACE	PRIMARY BF APPLICATION	REP. SIZES	PART NUMBERS	SCENARIOS
PSC Striking & Alignment Interfaces	Holding fasteners during trough skull-clearing and mud gun nozzle assembly; stove valve bolt work; gas main flange bolts; reline refractory chisel tasks	295 mm, 375 mm, 850 mm	PSC Striking & Alignment Interfaces	1·3·5·10·Shutdown

INTERFACE	PRIMARY BF APPLICATION	REP. SIZES	PART NUMBERS	SCENARIOS
PSC Chisel & Punch Holder	Chisel work during trough skull clearing, refractory removal in furnace reline, and stove checker brick removal; removes holding hand from strike zone	Fits chisels to 1" dia.	PSC Striking & Alignment Interfaces	1 · Shutdown · Contractor

MANUAL HANDLING INTERFACES

INTERFACE	PRIMARY BF APPLICATION	REP. SIZES	PART NUMBERS	SCENARIOS
PSC Lift Assist® Single Handle	Carrying individual refractory bricks, stove valve components, and mud gun nozzle assemblies without direct grip on hot or heavy surfaces	50 mm × 900 mm	PSC Manual Lifting Interfaces	3·5·Shutdown·Contractor

INTERFACE	PRIMARY BF APPLICATION	REP. SIZES	PART NUMBERS	SCENARIOS
PSC Lift Assist® Double Handle	Two-person carrying of heavier stove internals, trough lining sections, and reline components during campaign and shutdown	50 mm × 1500 mm	PSC Manual Lifting Interfaces	Shutdown · Contractor

INTERFACE	PRIMARY BF APPLICATION	REP. SIZES	PART NUMBERS	SCENARIOS
PSC Specialised Maintenance Interfaces	Safe handling of gas cylinders in the gas cleaning plant maintenance area and throughout the cast house service areas	230 mm, 254 mm	PSC Specialised Maintenance Interfaces	Contractor

— APPLICATION-SPECIFIC ENGINEERING GUIDANCE

If any hand exposure scenario in this chapter reflects tasks in your plant, PSC Hand Safety India can provide a engineering guidance indication for representative interfaces to consider. A engineering guidance is a starting point for evaluating whether an engineered interface is worth pursuing — it is not a binding commitment.

INFORMATION TO PROVIDE

1. Department / plant area (e.g. BF — Cast House Trough)
2. Specific task or hand exposure scenario
3. Component weight and approximate dimensions
4. Whether the component is ferrous (magnetic interface applicable)
5. Residual heat level at the time of task (hot / warm / ambient)
6. Indicative quantity of interfaces required
7. Plant name and location

WHAT PSC PROVIDES

- Recommended interface and size for the task
- Indicative unit price (budgetary, not binding)
- Delivery lead time from Visakhapatnam
- Application notes for the specific scenario
- Trial order option for field evaluation
- Reference to comparable applications in similar plants

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Hand Exposure in Integrated Steel Plants — A Department-by-Department Engineering Reference
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Chapter 5 of 22 · Version 2

ENGINEER THE HAND OUT OF THE HAZARD™

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CHAPTER 06 OF 22

Steel Melt Shop

BOF / LD Converter

This chapter identifies typical manual hand exposure scenarios encountered in this department of an integrated steel plant and highlights representative PSC application solutions commonly used for similar industrial tasks. Final product selection should always consider the specific task, component geometry, operating environment and site risk assessment.

1 DEPARTMENT OVERVIEW

Facilitator opening: Ask the audience where, in the Steel Melt Shop, the last recorded hand injury in their plant occurred. In most SMS departments the answer points to one of three places: the ladle preparation bay, the converter mouth during maintenance, or the alloy addition area. None of these is surprising — but in most plants, none of them has had a systematic task-level hand exposure review. The aim of this chapter is to provide the framework for that review.

The Steel Melt Shop converts liquid hot metal from the blast furnace into steel. In the basic oxygen furnace (BOF) route, hot metal is charged into the converter along with steel scrap, and oxygen is blown through a lance at high velocity to oxidise carbon and impurities. The resulting steel is tapped into a ladle, treated at the ladle metallurgy station, and transferred to the continuous caster. Slag from the converter is tipped into slag pots and processed separately.

From a hand safety perspective, the SMS presents a dense concentration of high-energy, high-consequence hand exposure scenarios. The converter itself, the ladle preparation and transfer operations, the alloy and flux addition systems, the slag handling area, and the gas recovery and cleaning systems all generate maintenance and operational tasks where hands are regularly exposed to pinch, crush, line-of-fire, and thermal hazards — often simultaneously and often under production time pressure.

2 MAJOR EQUIPMENT

BOF CONVERTER & TRUNNION

Large tilting vessel in which hot metal is converted to steel by oxygen blowing. The converter mouth, trunnion bearings, tilting mechanism, and refractory lining are all maintenance access points — near the highest-temperature zone in the SMS.

OXYGEN LANCE & LANCE CARRIAGE

Water-cooled lance that delivers oxygen into the converter. The lance tip, body sections, coupling, and the carriage mechanism require maintenance. Lance changes and coupling operations involve hand contact with heavy, hot equipment near the converter mouth.

STEEL LADLE & LADLE TURRET

Large refractory-lined vessels that receive steel from the converter tapping hole and transfer it to the caster. Ladle preparation — slide gate maintenance, purging plug fitting, refractory inspection — and ladle transfer crane operations are key hand exposure points.

ALLOY & FLUX ADDITION SYSTEM

Conveyor, hopper, and chute system delivering alloying materials and fluxes to the converter and ladle. Chute blockages, liner wear, and weight system maintenance generate regular hand exposure in the alloy addition area.

SLAG POT & SLAG HANDLING

Slag pots receive converter slag during tipping and are moved by crane or transfer car. Slag pot preparation, positioning, and crane transfer operations require load control and guidance at every cycle.

GAS RECOVERY HOOD & DUCT

Captures and recovers converter gas during the blow. The hood, water-cooled duct panels, skirts, and seal systems require periodic maintenance access — in a hot, gas-contaminated environment during planned outages.

3

MANUAL TASKS & HAND EXPOSURE SCENARIOS

• HIGH • EXPOSURE FREQUENCY		
Ladle Preparation — Slide Gate & Purging Plug Fitting		PINCH / CRUSH / BURNS
WHY THE HAND IS THERE Between heats, ladle slide gates are inspected and replaced, and purging plugs are fitted or replaced. The slide gate plate, spring assembly, and actuator mechanism require hands-on positioning. Purging plug connectors must be aligned and secured by hand in the ladle bottom — with ladle at elevated temperature from the previous heat. <i>"During slide gate plate replacement, how is the new plate held in alignment while the retaining spring or frame is engaged — and where is the holding hand at the moment of engagement?"</i> ENGINEERING INTERFACE CONSIDERATION Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.	HAND INTERFACE Slide gate plate face and frame, spring clip, purging plug body and argon connector, ladle bottom structure	EXPOSURE TYPE Pinch between slide gate plate and frame during installation; burns from ladle residual heat; crush between purging plug and ladle bottom recess
• HIGH • EXPOSURE FREQUENCY		
Ladle Transfer — Crane Hook & Trunnion Operations		LINE-OF-FIRE / CRUSH
WHY THE HAND IS THERE Steel ladles are lifted and transferred by overhead crane at every heat. The crane hook must be engaged and released at the ladle trunnion, and slings or lifting beams must be positioned and removed — with the ladle containing steel or being prepared for the next heat in a hot condition. <i>"When the ladle crane hook is being engaged or released at the trunnion, what is the position of the worker's hand relative to the hook and trunnion interface — and at what point is that hand withdrawn?"</i> ENGINEERING INTERFACE CONSIDERATION Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.	HAND INTERFACE Crane hook at ladle trunnion, lifting beam end, sling body and eye, ladle trunnion housing	EXPOSURE TYPE Hand in line of fire of ladle movement during guidance; crush between lifting beam and ladle trunnion; hand struck if sling shifts during crane approach

3

MANUAL TASKS & HAND EXPOSURE SCENARIOS — CONTINUED

• HIGH • EXPOSURE FREQUENCY		
Converter Mouth — Skull Clearing & Deslagging		BURNS / STRUCK-BY / LINE-OF-FIRE
WHY THE HAND IS THERE	HAND INTERFACE	EXPOSURE TYPE
Steel and slag skull accumulates on the converter mouth and lip between heats and must be removed using bars, oxygen lances, and mechanical tools. Workers approach the converter mouth — tilted to the working position — to apply clearing tools, with the converter interior retaining heat from the previous blow.	Skull bar handle, oxygen lance body, converter mouth rim, dislodged skull fragment during clearing	Burns from radiant heat at converter mouth; hand struck by dislodged skull falling from the mouth rim; hand in line of fire of skull fragment ejection during lance application
<i>"When the converter is tilted for skull clearing, what is the minimum distance maintained between the worker's hands and the converter mouth — and is that distance defined in the task procedure or established by custom?"</i>		
ENGINEERING INTERFACE CONSIDERATION		
Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.		

• HIGH · EXPOSURE FREQUENCY

Slag Pot — Crane Positioning & Transfer Car Operations

LINE-OF-FIRE / CRUSH

WHY THE HAND IS THERE	HAND INTERFACE	EXPOSURE TYPE
Slag pots are positioned under the converter tapping spout and tipping position by crane and transfer car. Workers guide the pot into position, signal the crane, and release rigging — with a hot converter above and a pot that may be receiving molten slag imminently.	Crane hook at slag pot trunnion, transfer car coupling, slag pot body during guidance, rigging eye	Hand in line of fire of pot movement during crane guidance; crush between pot and transfer car structure; hand struck if crane hook shifts at trunnion

"When a slag pot is positioned under the tipping converter, what tool or method is used to guide the pot into position — and does that method keep the worker's hands outside the pot movement path?"

ENGINEERING INTERFACE CONSIDERATION

Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.

• MEDIUM · EXPOSURE FREQUENCY

Oxygen Lance — Change & Coupling Operations

CRUSH / BURNS

WHY THE HAND IS THERE	HAND INTERFACE	EXPOSURE TYPE
Oxygen lances are changed periodically when the tip burns back or the lance body is damaged. The lance — a long, heavy, water-cooled tube — must be uncoupled from the carriage water and oxygen connections and replaced. Workers handle lance body sections and couple connections by hand near the hot converter mouth zone.	Lance body (hot lower section), water and oxygen coupling, lance carriage clamp, suspension hook	Burns from hot lance tip and body sections; hand crushed between lance body and carriage structure during uncoupling; pinch at coupling connection during engagement

"During a lance change, at what point in the sequence does the worker's hand contact the lance body — and what is the residual condition of the lance at that point?"

ENGINEERING INTERFACE CONSIDERATION

Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.

• HIGH • EXPOSURE FREQUENCY		
Alloy Addition System — Chute Blockage Clearing & Liner Replacement		CAUGHT-BETWEEN / PINCH
WHY THE HAND IS THERE Alloy and flux addition chutes block frequently due to the varying physical form of the materials — lumps, powder, and agglomerates. Liner plates inside chutes wear and require replacement. Workers reach into chute inspection openings or enter the chute body to clear blockages and change liners.	HAND INTERFACE Chute opening edge, clearing bar handle, liner plate face and edge, retaining bolt, chute body interior	EXPOSURE TYPE Hand struck by material surge when blockage releases; caught-between risk at chute opening during clearing; hand crushed between liner and chute body during positioning
<i>"In the alloy addition chute system, when a blockage is detected during a heat, what is the procedure — and is manual clearing attempted while the downstream ladle is in the tapping position?"</i>		
ENGINEERING INTERFACE CONSIDERATION Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.		

• MEDIUM · EXPOSURE FREQUENCY

Converter Trunnion & Tilting Mechanism — Maintenance**CRUSH / PINCH****WHY THE HAND IS THERE**

Trunnion bearings, tilting drive gearboxes, and coupling mechanisms on the converter require periodic maintenance. Workers access these large, heavy components — often in elevated positions on the converter platform — to inspect, lubricate, and replace parts. The trunnion ring, bearing housing, and gear coupling are all hand contact points during maintenance.

HAND INTERFACE

Trunnion ring face, bearing housing, gear coupling half, retaining bolt, lubrication point fitting

EXPOSURE TYPE

Hand crushed between coupling halves during engagement; pinch at bearing housing during component installation; hand in contact with hot trunnion surfaces during inspection

"During converter trunnion bearing maintenance, what method is used to hold bearing components in position during bolt engagement — and what does the holding hand contact during that operation?"

ENGINEERING INTERFACE CONSIDERATION

Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.

• MEDIUM · EXPOSURE FREQUENCY

Gas Recovery Hood — Water Panel & Skirt Maintenance**BURNS / PINCH****WHY THE HAND IS THERE**

Water-cooled hood panels, skirt sections, and seal components require replacement when they fail or wear. Hood maintenance is carried out during planned outages. Workers handle heavy panel sections, position them by hand against the hood structure, and engage fixing bolts — in an environment with residual heat from the previous heats.

HAND INTERFACE

Hood panel face and water connection, skirt body and mounting flange, retaining bolt, hood structure inner frame

EXPOSURE TYPE

Burns from residual heat on hood surfaces; hand pinched between panel and mounting frame during positioning; pinch at bolt hole during alignment

"When a replacement hood water panel is positioned against the hood structure, what holds it in alignment while mounting bolts are engaged — and what happens to the holding hand if the panel shifts?"

ENGINEERING INTERFACE CONSIDERATION

Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.

4 SHUTDOWN & OVERHAUL — ADDITIONAL EXPOSURE

LOW exposure frequency refers to how often the hand is exposed in normal operations, not to the consequence if contact occurs.

TASK	HAND EXPOSURE	FREQ.	EXPOSURE	PSC ENGINEERING INTERFACE PORTFOLIO
Converter reline — refractory removal	Workers inside the converter removing worn lining by bar and mechanical tool; confined cylindrical space, residual heat	LOW	BURNS/ABRASION	PSC Manual Lifting Interfaces · PSC Striking & Alignment Interfaces
TASK	HAND EXPOSURE	FREQ.	EXPOSURE	PSC ENGINEERING INTERFACE PORTFOLIO
Converter reline — brick laying	Refractory bricks handled individually inside the converter vessel; carried from staging through access opening	LOW	ABRASION/CRUSH	PSC Manual Lifting Interfaces
TASK	HAND EXPOSURE	FREQ.	EXPOSURE	PSC ENGINEERING INTERFACE PORTFOLIO
Ladle lining inspection & repair (cold)	Workers inside cold ladle inspecting and repairing lining; bricks and castable handled in confined cylindrical space	MED	ABRASION/CRUSH	PSC Manual Lifting Interfaces · PSC Striking & Alignment Interfaces
TASK	HAND EXPOSURE	FREQ.	EXPOSURE	PSC ENGINEERING INTERFACE PORTFOLIO
Converter trunnion bearing replacement	Large bearing assemblies lifted by crane and guided manually onto trunnion shaft during installation	LOW	CRUSH	PSC Load Control Interfaces · PSC Position & Reach Interfaces

5 CONTRACTOR & MOBILE EQUIPMENT INTERFACES

ACTIVITY / EQUIPMENT	HAND EXPOSURE SCENARIO	EXPOSURE	PSC ENGINEERING INTERFACE PORTFOLIO
Converter reline contractor	Full converter brick lining; large workforce handling bricks inside the vessel throughout the reline campaign	BURNS ABRASION	PSC Manual Lifting Interfaces · PSC Striking & Alignment Interfaces
ACTIVITY / EQUIPMENT	HAND EXPOSURE SCENARIO	EXPOSURE	PSC ENGINEERING INTERFACE PORTFOLIO
Rigging crew (ladle & slag pot)	Slinging and guiding ladles, slag pots, and converter components during crane maintenance lifts throughout the SMS	LINE-OF-FIRE	PSC Load Control Interfaces
ACTIVITY / EQUIPMENT	HAND EXPOSURE SCENARIO	EXPOSURE	PSC ENGINEERING INTERFACE PORTFOLIO
Ladle transfer crane (production)	Crane hook engagement and release at ladle trunnion at every heat; hand guidance of ladle during positioning at tapping and at caster	CRUSH	PSC Load Control Interfaces · PSC Position & Reach Interfaces

6 SMS QUICK ASSESSMENT CHECKLIST

Use during a plant walkdown or shutdown planning session. Answer based on current observed practice.

- ☐ Is the slide gate plate held by hand against the ladle frame while the retaining spring or mechanism is engaged?
- ☐ During ladle crane hook engagement at the trunnion, does the worker's hand contact the hook, sling, or trunnion housing directly?
- ☐ During converter skull clearing, are workers' hands within arm's reach of the converter mouth while applying clearing tools?
- ☐ When a slag pot is positioned under the converter tipping spout, does guidance involve direct hand contact with the pot or its rigging?
- ☐ Is the oxygen lance body held by hand during coupling and uncoupling from the carriage water and gas connections?
- ☐ Are alloy addition chute blockages cleared manually while the downstream ladle is in the tapping position?
- ☐ During ladle sampling, does the operator's free hand move into the radiant zone above the ladle rim?
- ☐ Are ladle crane lifts during production controlled with anti-tangle taglines throughout the full landing sequence?

If you answered **Yes** to any of the above, PSC can review those tasks and recommend representative hands-free engineered interfaces to consider. Contact Shivani at **+91-96031-66448** or **sales@pschandsafety.com**

7 PSC ENGINEERING INTERFACE PORTFOLIO — STEEL MELT SHOP

Representative PSC interfaces to consider for hand exposure scenarios identified in this chapter. Contact PSC for the full range and engineering guidance specific to your application.

LOAD CONTROL INTERFACES

INTERFACE	PRIMARY SMS APPLICATION	REP. SIZES	PART NUMBERS	SCENARIOS
PSC Load Control Interfaces	Controlling steel ladles, slag pots, and converter components during all SMS crane operations — production and maintenance	20 ft, 25 ft, 30 ft	PSC Load Control Interfaces	2-4-Contractor
PSC Load Control Interfaces	Attaching and retrieving taglines on ladles and converter components without entering the suspended load zone	10 m, 15 m	PSC Load Control Interfaces	Contractor
PSC RiggerMate® Hook	Positioning sling eyes and crane hooks during ladle, slag pot, and converter component crane lifts without direct hand contact	Single size	PSC Load Control Interfaces	2-4-Contractor

POSITION & REACH INTERFACES

INTERFACE	PRIMARY SMS APPLICATION	REP. SIZES	PART NUMBERS	SCENARIOS
PSC Load Control Interfaces · PSC Position & Reach Interfaces	Converter mouth standoff during skull clearing; slag pot guidance during crane positioning; ladle guidance; sampling lance support	42", 50", 72", 96"	PSC Position & Reach Interfaces	3-4-9
Guide-It® Push/Pull Pole	Guiding and spotting ladles, slag pots, and converter components during crane lifts; alloy chute standoff clearing	50", 72"	PSC Position & Reach Interfaces	4-6-Contractor
PSC Load-It® Push Pull Tool	Alloy addition chute blockage clearing; hood water panel positioning; converter trunnion maintenance guidance	4 ft, 6 ft	PSC Position & Reach Interfaces	5-6-8-9
3P Xtend Tool	Converter mouth and alloy chute blockage clearing at extended reach without entering the hazard zone; extends to 12 ft	6 ft / 12 ft extended	PSC Load Control Interfaces	3-6

MAGNETIC HANDLING INTERFACES

7 PSC ENGINEERING INTERFACE PORTFOLIO — STEEL MELT SHOP — CONTINUED

INTERFACE	PRIMARY SMS APPLICATION	REP. SIZES	PART NUMBERS	SCENARIOS
PSC Load-It® Mag (Non-Extendable · 500 lbs)	Positioning ferrous alloy chute liners and hood water panel sections where compatible with component geometry and access	4 ft, 6 ft	PSC Magnetic Handling Interfaces · PSC Position & Reach Interfaces	6-8

STRIKE & ALIGN INTERFACES

INTERFACE	PRIMARY SMS APPLICATION	REP. SIZES	PART NUMBERS	SCENARIOS
PSC Striking & Alignment Interfaces	Holding fasteners during slide gate installation, lance coupling, trunnion bearing bolt work, converter reline chisel tasks, ladle lining repair	295 mm, 375 mm, 850 mm	PSC Striking & Alignment Interfaces	1-5-7-Shutdown

INTERFACE	PRIMARY SMS APPLICATION	REP. SIZES	PART NUMBERS	SCENARIOS
PSC Chisel & Punch Holder	Chisel work during converter and ladle refractory removal in relining campaigns; removes holding hand from strike zone	Fits chisels to 1" dia.	PSC Striking & Alignment Interfaces	Shutdown · Contractor

MANUAL HANDLING INTERFACES

INTERFACE	PRIMARY SMS APPLICATION	REP. SIZES	PART NUMBERS	SCENARIOS
PSC Lift Assist® Single Handle	Carrying slide gate plates, lance sections, refractory bricks, and small maintenance components without gripping hot or heavy surfaces directly	50 mm × 900 mm	PSC Manual Lifting Interfaces	1-5-Shutdown-Contractor

INTERFACE	PRIMARY SMS APPLICATION	REP. SIZES	PART NUMBERS	SCENARIOS
PSC Lift Assist® Double Handle	Two-person carrying of heavier hood panel sections, converter lining components, and ladle maintenance parts	50 mm × 1500 mm	PSC Manual Lifting Interfaces	8-Shutdown-Contractor

INTERFACE	PRIMARY SMS APPLICATION	REP. SIZES	PART NUMBERS	SCENARIOS
PSC Specialised Maintenance Interfaces	Safe handling of argon, oxygen, and nitrogen cylinders in the ladle preparation bay and maintenance areas throughout the SMS	230 mm, 254 mm	PSC Specialised Maintenance Interfaces	Contractor

— APPLICATION-SPECIFIC ENGINEERING GUIDANCE

If any hand exposure scenario in this chapter reflects tasks in your plant, PSC Hand Safety India can provide a engineering guidance indication for representative interfaces to consider. A engineering guidance is a starting point for evaluating whether an engineered interface is worth pursuing — it is not a binding commitment.

INFORMATION TO PROVIDE

1. Department / plant area (e.g. SMS — Ladle Preparation Bay)
2. Specific task or hand exposure scenario
3. Component weight and approximate dimensions
4. Whether the component is ferrous (magnetic interface applicable)
5. Residual heat level at the time of task (hot / warm / ambient)
6. Indicative quantity of interfaces required
7. Plant name and location

WHAT PSC PROVIDES

- Recommended interface and size for the task
- Indicative unit price (budgetary, not binding)
- Delivery lead time from Visakhapatnam
- Application notes for the specific scenario
- Trial order option for field evaluation
- Reference to comparable applications in similar plants

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ENGINEER THE HAND OUT OF THE HAZARD™

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Secondary Metallurgy

Ladle Furnace · RH Degasser · Vacuum Treatment

This chapter identifies typical manual hand exposure scenarios encountered in this department of an integrated steel plant and highlights representative PSC application solutions commonly used for similar industrial tasks. Final product selection should always consider the specific task, component geometry, operating environment and site risk assessment.

1 DEPARTMENT OVERVIEW

Facilitator opening: Ask the audience how many secondary metallurgy treatments their plant performs per day — then ask whether there has ever been a task-level hand exposure review for ladle electrode handling, snorkel maintenance, or wire injection operations. The volume of treatments is high; the depth of hand safety analysis in this area is almost always low. That gap is the starting point for this chapter.

Secondary metallurgy — also called secondary steelmaking or ladle metallurgy — covers the processing steps between the primary steelmaking converter and the continuous caster. Liquid steel in the ladle is subjected to one or more refining treatments to achieve precise composition, temperature, and cleanliness targets before casting. The principal equipment categories are: ladle furnace (LF), which provides arc heating and stirring; vacuum degassers (RH, VD, VAD), which remove dissolved gases under vacuum; and powder injection and wire feeding systems, which introduce alloying and desulphurising agents into the ladle. Some plants operate several of these in sequence for high-specification steel grades.

From a hand safety perspective, secondary metallurgy generates a specific pattern of hand exposure that differs from the converter shop. Production rates are high — multiple ladles treated per hour on each station — and the maintenance windows between treatments are short. Electrode handling, snorkel and vacuum vessel maintenance, wire guide maintenance, and ladle positioning operations all require manual hand interaction with hot, heavy, or energised equipment under time pressure.

2 MAJOR EQUIPMENT

LADLE FURNACE (LF)

Arc reheating and stirring station. Three graphite electrodes descend into the ladle through the LF roof and supply arc heat. Electrode segments, electrode clamps, the roof itself, and the argon purging system are the main maintenance access points.

RH VACUUM DEGASSER

Recirculation degassing vessel with two snorkel tubes (upper and lower) immersed in the ladle. The vessel, snorkels, upper and lower vessel refractory, and oxygen blowing lance require maintenance. Snorkel refractory is renewed between campaign cycles.

VD / VAD VACUUM TANK

Tank-type degassing vessels that enclose the entire ladle. The vessel lid, lid seal, ladle lifting table, and argon purging system require maintenance. Wire feeding guide tubes pass through the lid and are replaced periodically.

WIRE FEEDING SYSTEM

Feeding machines inject cored wire — calcium, carbon, aluminium, sulphur, and alloy combinations — into the ladle at precise rates. Guide tubes, feed rollers, wire reels, and chute systems require frequent maintenance and replacement.

LADLE TRANSFER CAR & LADLE TURRET

Moves ladles between treatment stations and the caster. Rail cars, turret arms, and ladle support saddles require maintenance. Coupling and positioning operations involve hand contact with large, heavy structures in a hot environment.

ALLOY ADDITION & FLUX SYSTEM

Bins, belt conveyors, and chute systems deliver alloying additions to the ladle during treatment. Chute blockages, bin liner wear, and belt maintenance are the primary hand exposure points — the same pattern as in the SMS alloy addition system.

3 MANUAL TASKS & HAND EXPOSURE SCENARIOS

• HIGH • EXPOSURE FREQUENCY

Ladle Furnace — Electrode Segment Handling & Coupling

CRUSH / BURNS / ELECTRICAL

WHY THE HAND IS THERE

Graphite electrode segments must be periodically added to the electrode column as consumption occurs, or replaced when a segment breaks. New segments are threaded onto the electrode column nipple by crane — and the joint must be tightened by hand. Workers handle heavy graphite segments (50–200 kg) that are fragile and hot from previous operation.

HAND INTERFACE

Electrode segment body and nipple end, electrode clamp face, coupling spanner, crane sling at electrode lifting eye

EXPOSURE TYPE

Crush between electrode segment and column during crane approach; burns from hot electrode residual heat; hand struck if electrode segment cracks during handling

"When an electrode segment is joined to the column by crane, what method is used to align the nipple during the final approach — and where does the worker's hand sit relative to the two mating surfaces at the moment of contact?"

ENGINEERING INTERFACE CONSIDERATION

Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.

• HIGH • EXPOSURE FREQUENCY

Ladle Furnace — Roof & Electrode Clamp Maintenance

BURNS / PINCH / CRUSH

WHY THE HAND IS THERE

The LF roof — a water-cooled or refractory panel structure with electrode ports — is lifted and positioned by crane at every ladle change. Electrode clamps on the roof must be inspected, adjusted, and replaced periodically. Workers handle heavy roof sections and access clamp mechanisms directly, often between treatments when the roof is still warm.

HAND INTERFACE

Roof panel body and edge (warm), electrode clamp face and adjustment bolt, crane hook at roof lifting eye, electrode port rim

EXPOSURE TYPE

Burns from warm roof surfaces; hand crushed between roof and ladle rim during lowering; pinch at clamp mechanism during adjustment

"When the LF roof is lowered onto the ladle, what method is used to guide it into position — and is the guidance hand clear of the roof perimeter before the roof contacts the ladle rim?"

ENGINEERING INTERFACE CONSIDERATION

Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.

• MEDIUM • EXPOSURE FREQUENCY

RH Degasser — Snorkel Refractory Maintenance

BURNS / ABRASION / CRUSH

WHY THE HAND IS THERE

RH snorkels (the two immersion tubes at the base of the degassing vessel) accumulate skull build-up and suffer refractory wear between campaign cycles. Snorkel refractory is renewed by manual gunning and patching. Workers position gunning equipment and apply refractory material near the snorkel mouth — which retains heat from the previous campaign.

HAND INTERFACE

Gunning lance handle, snorkel mouth rim (hot refractory), skull material, vessel lower structure

EXPOSURE TYPE

Burns from residual heat at snorkel mouth; abrasion from skull material during clearing; hand crushed between gunning equipment and snorkel flange

"During snorkel refractory maintenance, how close does the gunning lance operator's hand approach the snorkel mouth — and is there a defined standoff distance, or does the operator judge it visually?"

ENGINEERING INTERFACE CONSIDERATION

Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.

• HIGH · EXPOSURE FREQUENCY

Wire Feeding System — Guide Tube & Roller Replacement

PINCH / CAUGHT-BETWEEN

WHY THE HAND IS THERE

Wire feeding guide tubes wear through repeated wire passage and must be replaced. Feed rollers — driven by motorised feeders — also require replacement when they groove or slip. Workers reach into the feeder housing to remove and replace rollers, and position new guide tubes through the lid of the VD tank or above the ladle, with the wire drive mechanism in close proximity.

HAND INTERFACE

Guide tube body and end fitting, feed roller face and shaft, feeder housing interior, drive belt, mounting bolt

EXPOSURE TYPE

Hand caught between feed roller and housing during roller change; finger drawn into drive belt; pinch between guide tube and lid fitting during assembly

"During wire feeder roller replacement, is the feeder drive fully isolated and locked out — or is the motor de-energised but the drive belt accessible under tension?"

ENGINEERING INTERFACE CONSIDERATION

Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.

• HIGH · EXPOSURE FREQUENCY

Ladle Positioning — Transfer Car & Turret Saddle Operations

LINE-OF-FIRE / CRUSH

WHY THE HAND IS THERE

Ladles are moved between the secondary metallurgy stations on transfer cars and ladle turrets. Workers guide ladles into position on saddles, couple and decouple argon purging connections, and position ladle lids and covers by hand — with the ladle at treatment temperature and adjacent equipment operating.

HAND INTERFACE

Ladle saddle and guide, argon purging hose and coupling, ladle lid rim and lifting eye, transfer car coupling

EXPOSURE TYPE

Hand in line of fire of ladle movement during saddle positioning; crush between ladle and transfer car structure; hand struck if argon hose pulls free under pressure

"When the argon purging connection is made to the ladle on the transfer car, what is the position of the worker's hands relative to the ladle movement path — and is the car confirmed stationary before connection?"

ENGINEERING INTERFACE CONSIDERATION

Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.

• MEDIUM · EXPOSURE FREQUENCY

VD / VAD Vessel — Lid Seal & Ladle Lid Maintenance

PINCH / CRUSH

WHY THE HAND IS THERE

The vacuum tank lid must seal against the vessel body at every treatment. Lid seals — rubber or silicone O-ring assemblies — wear and must be replaced. Workers position and seat the seal in the lid groove by hand. The lid itself is a large, heavy structure that must be guided during crane lowering onto the vessel.

HAND INTERFACE

Lid seal body in groove, lid underside and rim, vessel body seating face, crane hook at lid lifting eye

EXPOSURE TYPE

Pinch between seal and lid groove during installation; crush between lid and vessel rim during lowering; hand struck if crane hook slips at lid lifting point

"When the VD tank lid is lowered onto the vessel body, what method is used to guide it into the sealed position — and where is the worker's hand relative to the lid perimeter at the moment of contact?"

ENGINEERING INTERFACE CONSIDERATION

Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.

• HIGH · EXPOSURE FREQUENCY

Alloy Addition & Flux System — Chute Blockage Clearing

CAUGHT-BETWEEN / STRUCK-BY

WHY THE HAND IS THERE

Alloy and flux addition chutes in the secondary metallurgy area block frequently — the same pattern as in the SMS. Workers insert bars or rods through inspection openings, or in some plants manual intervention is attempted through the inspection openings, to clear blockages — often while the ladle treatment is ongoing and time pressure is high.

HAND INTERFACE

Chute opening edge, clearing bar handle, material face, bin discharge gate

EXPOSURE TYPE

Hand struck by material surge when blockage releases; caught-between at chute opening edge during clearing; hand struck by bin gate if opened unexpectedly

"In the secondary metallurgy alloy addition system, when a blockage occurs during treatment, what is the first action — and at what point does a hand approach the chute inspection opening?"

ENGINEERING INTERFACE CONSIDERATION

Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.

• MEDIUM · EXPOSURE FREQUENCY

RH Vessel — Upper & Lower Vessel Refractory Repair

BURNS / ABRASION / CRUSH

WHY THE HAND IS THERE

RH vessel refractory — upper and lower vessel lining, freeboard bricks, and snorkel brickwork — is repaired by gunning and manual patching between campaigns. Workers position gunning lances, handle individual bricks in the lower vessel area, and apply castable by hand in confined sections of the vessel interior.

HAND INTERFACE

Gunning lance body, refractory brick face and edge, vessel interior wall, castable application tool

EXPOSURE TYPE

Burns from residual heat in vessel interior; abrasion from refractory edges; hand crushed between brick and vessel wall during placement in confined lower vessel

"When individual bricks are placed in the lower RH vessel during repair, what method is used to carry the brick from the access point to the repair location — and how is the brick held in position during mortar application?"

ENGINEERING INTERFACE CONSIDERATION

Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.

• MEDIUM · EXPOSURE FREQUENCY

Ladle Furnace — Sampling & Temperature Lance Operations

BURNS / LINE-OF-FIRE

WHY THE HAND IS THERE

Temperature measurement and sampling at the ladle furnace is carried out by hand-held lance during or between arc heating periods. The operator inserts the probe lance through the LF roof opening into the steel bath — with the hand on the lance body above the ladle rim and in the radiant zone of the arc heating operation.

HAND INTERFACE

Lance body handle, sensor connector at lance tip, LF roof electrode port rim, ladle rim edge

EXPOSURE TYPE

Burns from radiant heat at roof opening; hand in line of fire of splashing steel if probe contacts the bath surface at an angle; burns from hot sensor connector after withdrawal

"During ladle furnace sampling, is the arc confirmed off before the lance is inserted through the roof port — and what is the position of the operator's free hand during insertion?"

ENGINEERING INTERFACE CONSIDERATION

Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.

4 SHUTDOWN & OVERHAUL — ADDITIONAL EXPOSURE

LOW exposure frequency refers to how often the hand is exposed in normal operations, not to the consequence if contact occurs. Secondary metallurgy vessel relines occur on campaign cycles — typically every few months for RH vessels and less frequently for LF roofs.

TASK	HAND EXPOSURE	FREQ.	EXPOSURE	PSC ENGINEERING INTERFACE PORTFOLIO
RH vessel full reline	Brick-by-brick lining of RH vessel interior; workers inside the vessel handling bricks and applying mortar throughout the campaign	LOW	BURNS / ABRASION	PSC Manual Lifting Interfaces · PSC Striking & Alignment Interfaces
LF roof replacement	Roof assembly lifted by crane and landed on the LF structure; workers guide the roof into position from the LF platform	LOW	CRUSH	PSC Load Control Interfaces · PSC Position & Reach Interfaces
Electrode arm & clamp overhaul	Electrode arm sections and clamp assemblies removed and replaced by crane; heavy components handled near energised bus bars	LOW	PINCH / CRUSH	PSC Load Control Interfaces · PSC Striking & Alignment Interfaces
VD tank vessel inspection & repair	Workers inside the VD vessel inspecting and patching lining; bricks and castable handled in confined cylindrical space	LOW	ABRASION / CRUSH	PSC Manual Lifting Interfaces · PSC Striking & Alignment Interfaces

5 CONTRACTOR & MOBILE EQUIPMENT INTERFACES

ACTIVITY / EQUIPMENT	HAND EXPOSURE SCENARIO	EXPOSURE	PSC ENGINEERING INTERFACE PORTFOLIO
Refractory reline contractor (RH)	Full RH vessel brick lining; workers inside the vessel handling bricks throughout the campaign on a repetitive basis	BURNS ABRASION	PSC Manual Lifting Interfaces · PSC Striking & Alignment Interfaces
Rigging crew (LF & RH)	Sliding and guiding LF roof panels, RH vessel sections, and electrode assemblies during crane maintenance lifts	LINE-OF-FIRE	PSC Load Control Interfaces
Ladle transfer crane (production)	Crane hook engagement at ladle trunnion at every treatment cycle; ladle guidance during positioning on saddles and turret arms	CRUSH	PSC Load Control Interfaces · PSC Position & Reach Interfaces

6 SECONDARY METALLURGY QUICK ASSESSMENT CHECKLIST

Use during a plant walkdown or shutdown planning session. Answer based on current observed practice.

- ☐ During electrode segment addition by crane, does the worker's hand contact the nipple or the face of either segment during the final joining approach?
- ☐ When the LF roof is lowered onto the ladle, does guidance involve hand contact with the roof perimeter or the ladle rim before the roof is fully seated?
- ☐ During RH snorkel refractory maintenance, does the gunning lance operator's hand approach within arm's reach of the snorkel mouth?
- ☐ During wire feeder roller replacement, is the drive belt accessible under tension while the worker's hand is inside the feeder housing?
- ☐ When the argon purging connection is made to the ladle on the transfer car, is the car confirmed stationary before the worker's hand approaches the coupling?
- ☐ During VD tank lid lowering, does the worker's hand contact the lid perimeter or the vessel seating face while the lid is in motion?
- ☐ In the secondary metallurgy alloy addition system, does the first response to a blockage involve a hand approaching the inspection opening before the chute is confirmed stationary?
- ☐ During ladle furnace sampling, is the arc confirmed off before the lance is inserted through the roof port?
- ☐ During RH vessel repair, are individual bricks carried to the repair location by bare hand grip on the brick face and edges?
- ☐ Are ladle crane and LF roof crane operations in this area controlled with anti-tangle taglines throughout the full landing sequence?

If you answered **Yes** to any of the above, PSC can review those tasks and recommend representative hands-free engineered interfaces to consider. Contact Shivani at **+91-96031-66448** or **sales@pschandsafety.com**

7 PSC ENGINEERING INTERFACE PORTFOLIO — SECONDARY METALLURGY

The following PSC engineering interfaces are relevant to the hand exposure scenarios identified in this chapter. This table introduces PSC product families and their primary engineering functions. It does not map any product to a specific scenario or application.

PSC LOAD CONTROL INTERFACES		
PSC ENGINEERING INTERFACE	PRIMARY FUNCTION	REPRESENTATIVE PART NUMBERS
PSC LoadGuider® Anti-Tangle Tagline	Controls suspended loads from a safe distance during crane operations	PSC-LGTC-15 PSC-LGTC-20 PSC-LGTC-25 PSC-LGTC-30
PSC Guidelt® Safety Rigger Tagline	Provides a safe, reusable tagline interface for controlling suspended loads from a stand-off distance throughout the lifting operation	PSC-GISRT-10 PSC-GISRT-15
PSC RiggerMate® Hook	Positions slings, shackles and rigging components without direct hand contact on rigging	PSC-RMH
PSC TaglineRetriever	Retrieves tagline rope ends after load landing without the operator entering the load zone	PSC-TRT PSC-TRT-3P
PSC POSITION & REACH INTERFACES		
PSC ENGINEERING INTERFACE	PRIMARY FUNCTION	REPRESENTATIVE PART NUMBERS
PSC LoadGuider® Push/Pull Pole	Pushes and pulls loads, components and rigging at a safe standoff distance	PSC-LG-42 PSC-LG-50 PSC-LG-72 PSC-LG-96
PSC Guide-It® Push/Pull Pole	Heavy-duty extended-reach push/pull for higher-force load guidance and positioning	PSC-GIT-50 PSC-GIT-72 PSC-GIT-96
PSC Load-It® Push/Pull Tool	Positions, guides and controls components using interchangeable heads suited to specific load geometries	PSC-LIT-S004 PSC-LIT-S006 PSC-LIT-S008
PSC SafeGuider Tool	Provides controlled standoff access to confined, hot or hazardous locations during maintenance	PSC-STGT-36 PSC-STGT-48
PSC MANUAL LIFTING INTERFACES		
PSC ENGINEERING INTERFACE	PRIMARY FUNCTION	REPRESENTATIVE PART NUMBERS
PSC Lift Assist Sling — Single Handle	Provides an engineered carry interface for components without a designed grip point, within manual handling limits	HSF-SH-075
PSC Lift Assist Sling — Double Handle	Provides a two-person engineered carry interface for longer components, within manual handling limits	HSF-DH-100
PSC Lift Assist Sling — Valve & Motor	Provides an engineered carry interface for valves, small motors and small pump bodies	HSF-CV
PSC Handle-Tech Pipe Lifter	Provides an engineered grip interface for pipe and hose carry without barrel gripping or finger-beneath-pipe contact	PSC-HTL-002 PSC-HTL-004 PSC-HTL-006
PSC EzyLift Pipe Lifting Tool	Provides a wrist-neutral lift interface for pipe and bar sections from floor or rack surfaces	PSC-EZYLFT
PSC STRIKING & ALIGNMENT INTERFACES		
PSC ENGINEERING INTERFACE	PRIMARY FUNCTION	REPRESENTATIVE PART NUMBERS
PSC FingerSaver®	Holds slogging spanners, drifts, chisels and punches during hammer striking, keeping the holding hand outside the impact zone	PSC-FS-295 PSC-FS-375 PSC-FS-850
PSC Chisel & Punch Holder	Holds narrow chisels and punches during light hammer striking where a smaller holding interface is required	PSC-CPH

7 PSC ENGINEERING INTERFACE PORTFOLIO — SECONDARY METALLURGY — CONTINUED

Selection of the appropriate engineering interface depends on the specific application, load characteristics, work method and site conditions. **Contact PSC Hand Safety India for application-specific engineering guidance and product recommendations.**

— APPLICATION-SPECIFIC ENGINEERING GUIDANCE

If any hand exposure scenario in this chapter reflects tasks in your plant or maintenance team, PSC Hand Safety India can provide application-specific engineering guidance. Bring the task, the component, the work method, and the site conditions — PSC will identify the most appropriate engineering interface for your specific application.

TO RECEIVE APPLICATION-SPECIFIC GUIDANCE, DESCRIBE:

1. The specific task or operation
2. The equipment type and component
3. The component weight and geometry
4. Whether the component is ferrous
5. The work method currently in use
6. The frequency of the task
7. The working environment and access constraints
8. Your plant name and location

ENGINEERING GUIDANCE

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Chapter 7 of 22 · Version 2

ENGINEER THE HAND OUT OF THE HAZARD™

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Continuous Casting Shop

This chapter identifies typical manual hand exposure scenarios encountered in this department of an integrated steel plant and highlights representative PSC application solutions commonly used for similar industrial tasks. Final product selection should always consider the specific task, component geometry, operating environment and site risk assessment.

1

DEPARTMENT OVERVIEW

Facilitator opening: Ask the audience whether their continuous caster has a specific hand safety procedure for tundish exchange — not just a permit-to-work, but a task-level procedure specifying where hands are positioned during each step. In most plants this is one of the highest-frequency crane and hot-metal-handling operations in the entire steelmaking complex, and task-level hand position is almost never documented. That is where this chapter begins.

The Continuous Casting Shop solidifies liquid steel from the ladle into semi-finished product — slab, bloom, or billet — for downstream rolling. Steel flows from the ladle through the tundish, then through the mould, where it begins to solidify. The partially solidified strand is guided and cooled through the secondary cooling zone by a series of driven rolls, then cut to length by a torch cutter or mechanical shear. The caster operates continuously for extended campaigns, interrupted only for sequence changes, tundish exchanges, and planned maintenance.

From a hand safety perspective, the caster presents a unique combination of hazards. The ladle-to-tundish zone involves large crane movements with filled vessels and hot refractory components. The tundish and mould areas combine hot liquid metal, ceramic and refractory components, and high-precision mechanical positioning. The strand guide and secondary cooling zone add roll maintenance, spray nozzle work, and segment handling. The cutting area and run-out table add heavy slab and product handling with mobile equipment.

2

MAJOR EQUIPMENT

LADLE TURRET & LADLE SHROUD

The ladle turret holds two ladles — one casting, one on standby. The ladle shroud — a refractory tube — connects the ladle nozzle to the tundish and is manually fitted and removed at each ladle change. Shroud manipulation is a primary hand exposure point at every sequence.

TUNDISH & TUNDISH CAR

The tundish distributes steel from the ladle to the individual mould strands. At the end of a sequence, the tundish — containing residual hot metal and skull — is exchanged by crane. Tundish preparation, lining inspection, and stopper rod fitting are key hand exposure points.

MOULD & MOULD TABLE

Copper mould plates form the initial solidification shell. The mould submerged entry nozzle (SEN) connects the tundish to the mould and is changed periodically during casting. Mould oscillation, cooling water connections, and mould level control instrumentation require periodic maintenance access.

STRAND GUIDE SEGMENTS

Rolls arranged in curved segments guide the solidifying strand from the mould to the straightening zone. Segment rolls, bearings, spray nozzles, and segment support structures require maintenance during planned stops — with residual heat from the strand and cooling water present.

TORCH CUTTER & SHEAR

Cuts the strand into prescribed lengths. The torch cutting unit traverses with the strand; the burner, guide carriage, and cutting torch require maintenance. Mechanical shears involve large blades and guides that require periodic inspection and replacement.

RUN-OUT TABLE & SLAB HANDLING

Driven roller tables transport cut slabs, blooms, or billets to the marking, inspection, and transfer areas. Roller table drive components, coupling guards, and the slab transfer equipment all require maintenance — with hot product moving nearby.

3 MANUAL TASKS & HAND EXPOSURE SCENARIOS

• HIGH • EXPOSURE FREQUENCY

Ladle Shroud — Fitting, Holding & Removal

BURNS / CRUSH / LINE-OF-FIRE

WHY THE HAND IS THERE

The ladle shroud — a long refractory tube — is manually fitted to the ladle nozzle at the start of each ladle and removed at the end. A shroud manipulator arm is used at some plants, but in many operations the shroud is still held by hand against the ladle nozzle while the ladle is opened. The shroud is hot from previous use and must be held in precise alignment.

HAND INTERFACE

Shroud body (hot refractory), ladle nozzle face, shroud holding clamp or rod, ladle slide gate area

EXPOSURE TYPE

Burns from hot shroud body; hand in line of fire of steel stream if shroud slips during ladle opening; crush between shroud and ladle nozzle face during fitting

"When the ladle shroud is positioned against the ladle nozzle, what holds it in place during the moment the slide gate is opened — and where is the operator's hand at that moment?"

ENGINEERING INTERFACE CONSIDERATION

Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.

• HIGH • EXPOSURE FREQUENCY

Tundish Exchange — Crane Operations & Positioning

LINE-OF-FIRE / CRUSH

WHY THE HAND IS THERE

At the end of a sequence, the hot tundish — containing residual liquid steel and skull — is lifted by crane and replaced with a preheated tundish. Workers guide the tundish during crane lowering onto the tundish car, align it with the mould, and connect the stopper rod actuator and argon lines — all while the tundish is hot and the mould below contains solidifying steel.

HAND INTERFACE

Crane hook at tundish lifting lug, tundish car saddle, stopper rod actuator coupling, argon hose fitting, tundish rim

EXPOSURE TYPE

Hand in line of fire of tundish movement during crane guidance; crush between tundish and car saddle during lowering; burns from hot tundish exterior and residual steel

"During a tundish exchange, how many workers are involved in guiding the incoming tundish onto the car — and at what point in the lowering sequence do their hands contact the tundish or its rigging?"

ENGINEERING INTERFACE CONSIDERATION

Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.

• HIGH • EXPOSURE FREQUENCY

Submerged Entry Nozzle (SEN) — Change During Casting

BURNS / CRUSH / PINCH

WHY THE HAND IS THERE

The SEN is changed periodically during the casting sequence using a slide-change mechanism. The new SEN must be pre-positioned, slid into place, and the alignment confirmed — with steel flowing through the adjacent nozzle and the mould immediately below. The SEN body is a precision refractory component handled in a hot, time-critical environment.

HAND INTERFACE

SEN body and end face, slide mechanism, SEN alignment clamp, tundish bottom structure

EXPOSURE TYPE

Burns from hot SEN and surrounding structure; hand crushed between SEN and slide mechanism during positioning; pinch at clamp during alignment under time pressure

"During an SEN change while steel is flowing, what holds the new SEN in alignment during the slide — and where are the operator's hands relative to the SEN body and the tundish bottom during that operation?"

ENGINEERING INTERFACE CONSIDERATION

Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.

• HIGH · EXPOSURE FREQUENCY

Tundish Preparation — Stopper Rod & Lining Inspection

BURNS / CRUSH / ABRASION

WHY THE HAND IS THERE

Between sequences, tundishes are prepared for the next cast: the lining is inspected and patched, the stopper rod is fitted and adjusted, and the tundish nozzle and well block are inspected. All of these involve hand access to a hot, abrasive refractory interior — with skull and solidified steel present from the previous sequence.

HAND INTERFACE

Tundish refractory lining interior (hot), stopper rod head and mounting shaft, well block face, skull clearing bar handle

EXPOSURE TYPE

Burns from hot tundish lining; abrasion from refractory and skull surfaces; hand crushed between stopper rod and mounting bracket during installation

"During stopper rod fitting in the tundish, what confirms the stopper rod head is correctly seated in the well block — and is that check made by visual inspection or by hand contact with the rod and block?"

ENGINEERING INTERFACE CONSIDERATION

Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.

• MEDIUM · EXPOSURE FREQUENCY

Strand Guide Segment — Roll & Bearing Replacement

CRUSH / BURNS / ABRASION

WHY THE HAND IS THERE

Strand guide rolls and bearings in the secondary cooling zone wear rapidly from the combination of mechanical load, thermal cycling, and water exposure. Roll replacement requires manual handling of heavy roll assemblies in confined segment spaces — with residual heat from the strand and wet, abrasive conditions throughout the segment zone.

HAND INTERFACE

Roll body and shaft end, bearing housing, segment frame, retaining bolt, segment support structure

EXPOSURE TYPE

Hand crushed between roll and segment frame during positioning; burns from residual heat on roll surface; abrasion from scale and oxide on strand guide surfaces

"In the strand guide, when a roll is removed and replaced, what positions the new roll in the segment while bearing housings are bolted — and what does the worker's hand contact during that alignment step?"

ENGINEERING INTERFACE CONSIDERATION

Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.

• HIGH · EXPOSURE FREQUENCY

Secondary Cooling — Spray Nozzle Replacement & Header Maintenance

PINCH / BURNS / LINE-OF-FIRE

WHY THE HAND IS THERE

Spray nozzles in the secondary cooling zone become blocked with scale and oxide deposits and must be replaced or cleaned. Spray headers and water connection fittings require maintenance. Workers reach into the confined strand guide space to access nozzles and fittings — with residual heat and water spray present, and the adjacent strand zone still warm from recent casting.

HAND INTERFACE

Spray nozzle body, header pipe fitting, isolation valve, scale deposit at nozzle seat

EXPOSURE TYPE

Hand in line of fire of pressurised water if isolation is incomplete; burns from hot header pipe; pinch between nozzle and header during removal and fitting

"When a spray nozzle is replaced in the secondary cooling zone, what confirms that the water supply to that header is isolated before the nozzle is removed — and is isolation confirmed by a physical check or by operating procedure alone?"

ENGINEERING INTERFACE CONSIDERATION

Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.

• MEDIUM · EXPOSURE FREQUENCY

Torch Cutter — Burner & Guide Maintenance

BURNS / CAUGHT-BETWEEN

WHY THE HAND IS THERE

The torch cutting unit traverses with the strand on a carriage. Burner nozzles, guide rails, the carriage drive mechanism, and the cutting torch body require periodic maintenance. Workers access the cutting unit when it is parked — in an area where scale, hot slab surfaces, and the traverse mechanism all create hand exposure risks.

HAND INTERFACE

Burner nozzle body, cutting torch handle, guide rail, carriage drive coupling, slab surface nearby

EXPOSURE TYPE

Burns from hot torch nozzle and adjacent slab surface; hand caught between carriage and rail during traverse mechanism maintenance; pinch at drive coupling

"When torch cutter maintenance is carried out, is the carriage drive positively isolated — or is it only de-energised at the panel while the carriage remains free to move on the rail?"

ENGINEERING INTERFACE CONSIDERATION

Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.

• MEDIUM · EXPOSURE FREQUENCY

Mould — Copper Plate & Water Box Maintenance

PINCH / CRUSH

WHY THE HAND IS THERE

Mould copper plates wear from contact with the solidifying steel shell and must be replaced. Water box connections, mould bolts, and the oscillation mechanism require periodic maintenance. Copper plates are heavy, precisely machined components that must be aligned and bolted — with the mould table and oscillation unit in close proximity.

HAND INTERFACE

Copper plate face and edge, mould frame, water box connection, mould bolt, oscillation drive coupling

EXPOSURE TYPE

Pinch between copper plate and mould frame during positioning; hand crushed between mould and oscillation table; pinch at water box connection during fitting

"When a mould copper plate is repositioned or replaced, what holds the plate against the mould frame while mounting bolts are engaged — and is the oscillation mechanism confirmed de-energised and mechanically locked before that work begins?"

ENGINEERING INTERFACE CONSIDERATION

Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.

• HIGH · EXPOSURE FREQUENCY

Run-out Table & Slab Transfer — Roller & Drive Maintenance

CAUGHT-BETWEEN / CRUSH

WHY THE HAND IS THERE

Run-out table rollers, drive couplings, and coupling guards require periodic inspection and replacement. Workers access roller drive components in an area where hot slabs move continuously on adjacent roller tables. Coupling pin work, guard fastening, and roller end-bearing inspection all involve the hand in proximity to moving or recently moving drive components.

HAND INTERFACE

Roller coupling pin and half, coupling guard fixing, roller end bearing housing, drive shaft

EXPOSURE TYPE

Hand caught between coupling halves during maintenance if adjacent roller restarts; crush at coupling guard during refitting; pinch at bearing housing during inspection

"During run-out table roller drive maintenance, what confirms that the specific roller drive — and not just the adjacent section — is isolated before the coupling guard is removed?"

ENGINEERING INTERFACE CONSIDERATION

Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.

4

SHUTDOWN & OVERHAUL — ADDITIONAL EXPOSURE

LOW exposure frequency refers to how often the hand is exposed in normal operations, not to the consequence if contact occurs.

TASK	HAND EXPOSURE	FREQ.	EXPOSURE	PSC ENGINEERING INTERFACE PORTFOLIO
Full segment exchange (crane lift)	Complete strand guide segments lifted by crane and guided manually into position on the caster frame during planned maintenance stops	LOW	CRUSH	PSC Load Control Interfaces · PSC Position & Reach Interfaces
Tundish refractory relining	Tundish lining spray or brick application; workers inside the tundish body applying castable and positioning bricks throughout the campaign	MED	ABRASION / BURNS	PSC Manual Lifting Interfaces · PSC Striking & Alignment Interfaces
Mould oscillation mechanism overhaul	Eccentric, drive shaft, and spring assemblies removed and replaced; heavy components guided by crane near the mould table	LOW	CRUSH / PINCH	PSC Load Control Interfaces · PSC Magnetic Handling Interfaces · PSC Position & Reach Interfaces · PSC Striking & Alignment Interfaces
Ladle turret arm bearing replacement	Large bearing assemblies lifted by crane and guided onto the turret arm shaft; workers guide in restricted platform space above the casting floor	LOW	CRUSH	PSC Load Control Interfaces · PSC Position & Reach Interfaces

5

CONTRACTOR & MOBILE EQUIPMENT INTERFACES

ACTIVITY / EQUIPMENT	HAND EXPOSURE SCENARIO	EXPOSURE	PSC ENGINEERING INTERFACE PORTFOLIO
Refractory contractor (tundish)	Tundish lining spray and brick application; repetitive handling of refractory materials inside the tundish body across the campaign	ABRASION BURNS	PSC Manual Lifting Interfaces · PSC Striking & Alignment Interfaces
Rigging crew (segment & tundish)	Slings and guiding strand guide segments and tundish assemblies during crane maintenance lifts on the caster floor	LINE-OF-FIRE	PSC Load Control Interfaces
Ladle transfer crane (production)	Crane hook engagement at ladle lifting lug at every ladle change; ladle guidance during positioning on the turret at the casting position	CRUSH	PSC Load Control Interfaces · PSC Position & Reach Interfaces

6 CONTINUOUS CASTING SHOP QUICK ASSESSMENT CHECKLIST

Use during a plant walkdown or shutdown planning session. Answer based on current observed practice.

- ☐ When the ladle shroud is positioned at the ladle nozzle, is the operator's hand on or near the shroud body at the moment the slide gate is opened?
- ☐ During a tundish exchange by crane, does guidance of the incoming tundish involve hand contact with the tundish body or its rigging while it is in motion?
- ☐ During an SEN change while casting, are the operator's hands in contact with the SEN body or the slide mechanism at the moment of the slide operation?
- ☐ During tundish stopper rod fitting, is the stopper rod head alignment confirmed by hand contact inside the tundish body?
- ☐ During strand guide roll replacement, does the worker's hand enter the segment space to position the roll while it is being guided toward the bearing housing?
- ☐ When a spray nozzle is replaced in the secondary cooling zone, is water isolation confirmed by physical check before the nozzle is removed?
- ☐ During torch cutter maintenance, is the carriage drive positively isolated and mechanically prevented from traversing while hands are on the torch or guide rail?
- ☐ During mould copper plate replacement, is the oscillation mechanism mechanically locked before the plate is positioned against the mould frame?
- ☐ During run-out table roller coupling maintenance, is the specific drive isolated — not just the section panel — before the coupling guard is removed?
- ☐ Are tundish and strand guide segment crane lifts controlled with anti-tangle taglines throughout the full landing sequence?

If you answered **Yes** to any of the above, PSC can review those tasks and recommend representative hands-free engineered interfaces to consider. Contact Shivani at **+91-96031-66448** or **sales@pschandsafety.com**

7 PSC ENGINEERING INTERFACE PORTFOLIO — CONTINUOUS CASTING

The following PSC engineering interfaces are relevant to the hand exposure scenarios identified in this chapter. This table introduces PSC product families and their primary engineering functions. It does not map any product to a specific scenario or application.

PSC LOAD CONTROL INTERFACES		
PSC ENGINEERING INTERFACE	PRIMARY FUNCTION	REPRESENTATIVE PART NUMBERS
PSC LoadGuider® Anti-Tangle Tagline	Controls suspended loads from a safe distance during crane operations	PSC-LGTC-15 PSC-LGTC-20 PSC-LGTC-25 PSC-LGTC-30
PSC Guidelt® Safety Rigger Tagline	Provides a safe, reusable tagline interface for controlling suspended loads from a stand-off distance throughout the lifting operation	PSC-GISRT-10 PSC-GISRT-15
PSC RiggerMate® Hook	Positions slings, shackles and rigging components without direct hand contact on rigging	PSC-RMH
PSC TaglineRetriever	Retrieves tagline rope ends after load landing without the operator entering the load zone	PSC-TRT PSC-TRT-3P
PSC POSITION & REACH INTERFACES		
PSC ENGINEERING INTERFACE	PRIMARY FUNCTION	REPRESENTATIVE PART NUMBERS
PSC LoadGuider® Push/Pull Pole	Pushes and pulls loads, components and rigging at a safe standoff distance	PSC-LG-42 PSC-LG-50 PSC-LG-72 PSC-LG-96
PSC Guide-It® Push/Pull Pole	Heavy-duty extended-reach push/pull for higher-force load guidance and positioning	PSC-GIT-50 PSC-GIT-72 PSC-GIT-96
PSC Load-It® Push/Pull Tool	Positions, guides and controls components using interchangeable heads suited to specific load geometries	PSC-LIT-S004 PSC-LIT-S006 PSC-LIT-S008
PSC SafeGuider Tool	Provides controlled standoff access to confined, hot or hazardous locations during maintenance	PSC-STGT-36 PSC-STGT-48
PSC STRIKING & ALIGNMENT INTERFACES		
PSC ENGINEERING INTERFACE	PRIMARY FUNCTION	REPRESENTATIVE PART NUMBERS
PSC FingerSaver®	Holds slogging spanners, drifts, chisels and punches during hammer striking, keeping the holding hand outside the impact zone	PSC-FS-295 PSC-FS-375 PSC-FS-850
PSC Chisel & Punch Holder	Holds narrow chisels and punches during light hammer striking where a smaller holding interface is required	PSC-CPH
Selection of the appropriate engineering interface depends on the specific application, load characteristics, work method and site conditions. Contact PSC Hand Safety India for application-specific engineering guidance and product recommendations.		

— APPLICATION-SPECIFIC ENGINEERING GUIDANCE

If any hand exposure scenario in this chapter reflects tasks in your plant or maintenance team, PSC Hand Safety India can provide application-specific engineering guidance. Bring the task, the component, the work method, and the site conditions — PSC will identify the most appropriate engineering interface for your specific application.

TO RECEIVE APPLICATION-SPECIFIC GUIDANCE, DESCRIBE:

1. The specific task or operation
2. The equipment type and component
3. The component weight and geometry
4. Whether the component is ferrous
5. The work method currently in use
6. The frequency of the task
7. The working environment and access constraints
8. Your plant name and location

ENGINEERING GUIDANCE

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Reheating Furnaces

This chapter identifies typical manual hand exposure scenarios encountered in this department of an integrated steel plant and highlights representative PSC application solutions commonly used for similar industrial tasks. Final product selection should always consider the specific task, component geometry, operating environment and site risk assessment.

1 DEPARTMENT OVERVIEW

Facilitator opening: Ask the audience whether their reheating furnace maintenance team treats furnace maintenance as a hot-work environment or a mechanical maintenance environment. Most crews say mechanical — because by the time maintenance begins the furnace is cool. But the discussion trigger for this chapter is different: ask them about burner inspection during operation, door maintenance between billets or slabs, and skid rail cleaning while the furnace is at temperature. That is where the hand exposure in this department actually occurs.

Reheating furnaces bring semi-finished steel — slabs, blooms, or billets from the caster or from storage — to rolling temperature before they enter the hot rolling mill. The furnace is a large, gas-fired box in which the material travels on a fixed or walking beam hearth from the charge end to the discharge end, absorbing heat progressively. At discharge, a pusher or walking beam mechanism extracts the material and transfers it to the rolling mill entry table. Furnaces operate continuously over extended campaigns and are shut down periodically for refractory inspection, burner maintenance, skid and water pipe repair, and door system overhaul.

From a hand safety perspective, the reheating furnace presents two distinct exposure profiles. During operation, maintenance activities near the charge door, discharge door, and burner inspection ports expose workers to radiant heat, escaping flame and gas, and heavy door mechanisms — often while the furnace is at operating temperature. During planned shutdown, the furnace interior requires refractory repair, skid rail work, water pipe maintenance, and burner removal — with the added complexity of confined space access inside a structure that retains heat long after the gas is shut off.

2 MAJOR EQUIPMENT

CHARGE & DISCHARGE DOORS

Heavy refractory-lined or water-cooled steel doors that seal the furnace at the charge and discharge ends. Doors are opened and closed hydraulically or mechanically for each charge and discharge cycle. Door frames, sealing faces, counterweights, and operating mechanisms require periodic maintenance.

SKID RAILS & WATER PIPES

The furnace hearth in a walking beam or pusher furnace is lined with refractory-covered water-cooled skid rails on which the material slides. The water pipes inside the skids are subject to scale accumulation, corrosion, and fatigue — requiring internal access during shutdown for inspection and replacement.

FURNACE REFRACTORY LINING

The furnace roof, walls, and hearth are lined with high-temperature refractory. Spalling, cracking, and erosion require repair during planned shutdowns. Workers access the furnace interior through doors or manhole openings with tools and materials, in a confined space that retains elevated temperature.

BURNER ASSEMBLIES

Gas and air burners arranged along the furnace walls and roof fire the furnace to temperature. Burner nozzles, quarls, pilots, and ignitors require periodic replacement. Burner block refractory around each burner opening also requires patching. Burner access is through ports in the furnace wall — near the active combustion zone.

WALKING BEAM / PUSHER MECHANISM

The walking beam mechanism lifts and advances material through the furnace. Beam drives, couplings, and lifting frames extend outside the furnace shell and require maintenance. Pusher mechanisms at the charge end operate in the hot zone immediately outside the charge door.

SCALE PIT & DE-SCALING SYSTEM

Scale accumulates on the furnace hearth and in the scale pit below the charge and discharge ends. Scale clearing — either mechanical or manual — is carried out periodically. The scale pit below the discharge door is a confined space with access during operation or planned stops, with hot scale and residual heat present.

3 MANUAL TASKS & HAND EXPOSURE SCENARIOS

• HIGH · EXPOSURE FREQUENCY

Charge & Discharge Door — Frame, Seal & Mechanism Maintenance

BURNS / CRUSH / PINCH

WHY THE HAND IS THERE

Furnace doors are opened and closed at every charge and discharge cycle. Door frame sealing faces accumulate scale and require manual cleaning. Counterweight cables, hydraulic cylinder pins, and door guide rollers require adjustment and replacement. Workers access these components on the operating furnace — with the door opening exposing the furnace interior directly.

HAND INTERFACE

Door frame sealing face (hot), counterweight cable end, hydraulic cylinder pin, door guide roller, door lifting arm

EXPOSURE TYPE

Burns from radiant heat at door opening; hand crushed between door and frame during seal cleaning; pinch at counterweight cable and sheave during adjustment

"During door seal face cleaning, at what point in the cycle is the cleaning carried out — and where is the worker's hand relative to the door face and the furnace opening during that operation?"

ENGINEERING INTERFACE CONSIDERATION

Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.

• MEDIUM · EXPOSURE FREQUENCY

Burner Assembly — Nozzle, Quarl & Pilot Replacement

BURNS / LINE-OF-FIRE

WHY THE HAND IS THERE

Burner nozzles and quarl blocks wear and require replacement. Pilot igniters and UV flame detectors require periodic servicing. Workers access burner ports in the furnace wall — where plant procedures permit — to remove and fit burner components. The burner port opens directly to the furnace interior at elevated temperature, and adjacent burners may remain lit during a single burner change on some installations.

HAND INTERFACE

Burner nozzle body, quarl refractory block, gas supply coupling, pilot assembly, burner port rim (hot)

EXPOSURE TYPE

Burns from radiant heat at the burner port; hand in line of fire of escaping flame or hot gas during burner removal; pinch at nozzle coupling during fitting

"When a burner nozzle is changed on an operating furnace where plant procedures permit this, at what point in the removal sequence is the worker's hand closest to the open burner port?"

ENGINEERING INTERFACE CONSIDERATION

Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.

• HIGH · EXPOSURE FREQUENCY

Scale Pit & Furnace Floor — Scale Clearing Operations

BURNS / ABRASION / CONFINED SPACE

WHY THE HAND IS THERE

Scale accumulates on the furnace floor and in the pit below the discharge end and must be cleared periodically. Workers use bars and shovels to break up and remove scale — which is hot, abrasive, and angular. The scale pit is a confined space with access through a restricted opening, and scale may be hot from recent operation.

HAND INTERFACE

Scale bar or shovel handle, scale pit access opening edge, scale material surface (hot), pit wall

EXPOSURE TYPE

Burns from hot scale material contact; abrasion and laceration from angular scale edges; hand struck if bar slips on hard scale surface

"When scale is cleared from the furnace floor between charges, is the clearing tool long enough to keep the worker's hands outside the radiant zone at the discharge door — or does the task require the worker to lean into the furnace opening?"

ENGINEERING INTERFACE CONSIDERATION

Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.

• MEDIUM · EXPOSURE FREQUENCY

Walking Beam / Pusher — Drive Coupling & Mechanism Maintenance**CRUSH / PINCH****WHY THE HAND IS THERE**

Walking beam drive shafts, eccentric mechanisms, couplings, and guide frames are accessed for lubrication, inspection, and component replacement outside the furnace shell. Coupling pins, drive shaft end flanges, and beam lifting frame pivot points are the primary hand contact points — in a hot, greasy environment at the side of the operating furnace.

HAND INTERFACE

Coupling pin and half, drive shaft flange, beam lifting frame pivot, grease nipple, retaining bolt

EXPOSURE TYPE

Hand crushed between coupling halves during pin insertion; pinch at beam lifting frame pivot during inspection; hand struck if bar slips during pin driving

"When coupling pins are inserted or removed on the walking beam drive, is the drive mechanically locked against movement — and what holds the coupling halves aligned while the pin is driven?"

ENGINEERING INTERFACE CONSIDERATION

Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.

• LOW · EXPOSURE FREQUENCY

Furnace Interior — Refractory Repair During Shutdown**BURNS / ABRASION / CONFINED SPACE****WHY THE HAND IS THERE**

During planned furnace shutdowns, refractory bricks and castable lining in the roof, walls, and hearth are inspected and repaired. Workers enter the furnace through the charge or discharge door or through manhole openings, carrying bricks and tools into a confined, still-warm space with uneven refractory surfaces underfoot and overhead.

HAND INTERFACE

Refractory brick face and edges, castable material, furnace wall interior, mortar application tool, confined access opening edge

EXPOSURE TYPE

Abrasion and cuts from refractory brick edges; burns from surfaces not fully cooled; hand crushed between brick and furnace wall during placement

"Before workers enter the furnace for refractory repair, what temperature measurement is taken at the work face — and is that measurement made at the point of work or at the furnace entry point?"

ENGINEERING INTERFACE CONSIDERATION

Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.

• LOW · EXPOSURE FREQUENCY

Skid Rail & Water Pipe — Inspection & Replacement**CRUSH / BURNS / CONFINED SPACE****WHY THE HAND IS THERE**

Skid rail water pipes are inspected during shutdowns for scale accumulation, corrosion, and fatigue cracking. Where replacement is required, pipe sections are removed and new sections positioned inside the furnace — carried by hand through the furnace access opening. The space between skid rails is confined, and residual heat and scale are present throughout.

HAND INTERFACE

Water pipe body (heavy steel tube), skid rail refractory cladding, pipe end flange, confined furnace floor, access opening edge

EXPOSURE TYPE

Burns from residual heat in pipe and skid rail; hand crushed between pipe section and skid structure during positioning; abrasion from scale on furnace floor

"When a replacement skid water pipe section is carried into the furnace, how is it transported from the furnace entrance to the installation position — and what does the worker's hand grip on the pipe body during that carry?"

ENGINEERING INTERFACE CONSIDERATION

Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.

4 SHUTDOWN & OVERHAUL — ADDITIONAL EXPOSURE

LOW exposure frequency refers to how often the hand is exposed in normal operations, not to the consequence if contact occurs. Furnace refractory campaigns involve large contractor workforces over extended periods in confined hot conditions.

TASK	HAND EXPOSURE	FREQ.	EXPOSURE	PSC ENGINEERING INTERFACE PORTFOLIO
Full furnace refractory reline	Complete replacement of roof, wall, and hearth lining; workers inside the furnace carrying and placing bricks throughout the campaign	LOW	BURNS / ABRASION	PSC Manual Lifting Interfaces · PSC Striking & Alignment Interfaces
Charge & discharge door replacement	Complete door assemblies lifted by crane and guided onto furnace door frame; heavy refractory-lined structure with restricted working space	LOW	CRUSH	PSC Load Control Interfaces · PSC Position & Reach Interfaces
Walking beam drive overhaul	Drive shaft, eccentric, and beam lifting frame components removed and replaced by crane; workers guide components in confined side-furnace space	LOW	CRUSH / PINCH	PSC Load Control Interfaces · PSC Position & Reach Interfaces · PSC Striking & Alignment Interfaces
Full skid rail system replacement	All water pipe and refractory-clad skid rail sections removed and replaced; individual pipe sections carried and positioned inside the furnace throughout the campaign	LOW	BURNS / CRUSH	PSC Manual Lifting Interfaces · PSC Striking & Alignment Interfaces

5 CONTRACTOR & MOBILE EQUIPMENT INTERFACES

ACTIVITY / EQUIPMENT	HAND EXPOSURE SCENARIO	EXPOSURE	PSC ENGINEERING INTERFACE PORTFOLIO
Refractory reline contractor	Full furnace brick lining campaign; large contractor workforce carrying and placing bricks in the confined furnace interior throughout the campaign	BURNS ABRASION	PSC Manual Lifting Interfaces · PSC Striking & Alignment Interfaces
Rigging crew (door & drive components)	Slings and guiding furnace door assemblies and walking beam drive components during crane maintenance lifts at the furnace ends	LINE-OF-FIRE	PSC Load Control Interfaces
Mobile crane (shutdown lifts)	Crane operations for door, drive, and structural component replacement at the charge and discharge ends in restricted yard space	CRUSH	PSC Load Control Interfaces · PSC Position & Reach Interfaces

6 REHEATING FURNACE QUICK ASSESSMENT CHECKLIST

Use during a plant walkdown or shutdown planning session. Answer based on current observed practice.

- ☐ During door seal face cleaning, does the worker's hand contact the door face or the furnace opening rim while the furnace is at operating temperature?
- ☐ When a burner nozzle is changed on an operating furnace where plant procedures permit, does the worker's hand approach within arm's reach of the open burner port?
- ☐ During scale clearing from the furnace floor, is the clearing tool long enough to keep the worker's hands outside the radiant zone at the furnace door?
- ☐ When walking beam coupling pins are inserted or removed, is the drive mechanically locked — and is the holding hand in the strike zone during pin driving?
- ☐ Before workers enter the furnace for refractory repair, is the temperature at the work face measured at the repair location — not only at the furnace entry point?
- ☐ When skid rail water pipe sections are carried into the furnace, does the worker's hand grip the bare pipe body directly?
- ☐ During furnace door replacement by crane, are anti-tangle taglines used throughout the full landing sequence onto the door frame?
- ☐ During scale pit clearing, is the pit confirmed as a confined space and treated accordingly — including atmospheric testing before entry?

If you answered **Yes** to any of the above, PSC can review those tasks and recommend representative hands-free engineered interfaces to consider. Contact Shivani at **+91-96031-66448** or **sales@pschandsafety.com**

7 PSC ENGINEERING INTERFACE PORTFOLIO — REHEATING FURNACES

The following PSC engineering interfaces are relevant to the hand exposure scenarios identified in this chapter. This table introduces PSC product families and their primary engineering functions. It does not map any product to a specific scenario or application.

PSC LOAD CONTROL INTERFACES		
PSC ENGINEERING INTERFACE	PRIMARY FUNCTION	REPRESENTATIVE PART NUMBERS
PSC LoadGuider® Anti-Tangle Tagline	Controls suspended loads from a safe distance during crane operations	PSC-LGTC-15 PSC-LGTC-20 PSC-LGTC-25 PSC-LGTC-30
PSC Guidelt® Safety Rigger Tagline	Provides a safe, reusable tagline interface for controlling suspended loads from a stand-off distance throughout the lifting operation	PSC-GISRT-10 PSC-GISRT-15
PSC RiggerMate® Hook	Positions slings, shackles and rigging components without direct hand contact on rigging	PSC-RMH
PSC TaglineRetriever	Retrieves tagline rope ends after load landing without the operator entering the load zone	PSC-TRT PSC-TRT-3P
PSC POSITION & REACH INTERFACES		
PSC ENGINEERING INTERFACE	PRIMARY FUNCTION	REPRESENTATIVE PART NUMBERS
PSC LoadGuider® Push/Pull Pole	Pushes and pulls loads, components and rigging at a safe standoff distance	PSC-LG-42 PSC-LG-50 PSC-LG-72 PSC-LG-96
PSC Guide-It® Push/Pull Pole	Heavy-duty extended-reach push/pull for higher-force load guidance and positioning	PSC-GIT-50 PSC-GIT-72 PSC-GIT-96
PSC Load-It® Push/Pull Tool	Positions, guides and controls components using interchangeable heads suited to specific load geometries	PSC-LIT-S004 PSC-LIT-S006 PSC-LIT-S008
PSC SafeGuider Tool	Provides controlled standoff access to confined, hot or hazardous locations during maintenance	PSC-STGT-36 PSC-STGT-48
PSC STRIKING & ALIGNMENT INTERFACES		
PSC ENGINEERING INTERFACE	PRIMARY FUNCTION	REPRESENTATIVE PART NUMBERS
PSC FingerSaver®	Holds slogging spanners, drifts, chisels and punches during hammer striking, keeping the holding hand outside the impact zone	PSC-FS-295 PSC-FS-375 PSC-FS-850
PSC Chisel & Punch Holder	Holds narrow chisels and punches during light hammer striking where a smaller holding interface is required	PSC-CPH
Selection of the appropriate engineering interface depends on the specific application, load characteristics, work method and site conditions. Contact PSC Hand Safety India for application-specific engineering guidance and product recommendations.		

— APPLICATION-SPECIFIC ENGINEERING GUIDANCE

If any hand exposure scenario in this chapter reflects tasks in your plant or maintenance team, PSC Hand Safety India can provide application-specific engineering guidance. Bring the task, the component, the work method, and the site conditions — PSC will identify the most appropriate engineering interface for your specific application.

TO RECEIVE APPLICATION-SPECIFIC GUIDANCE, DESCRIBE:

1. The specific task or operation
2. The equipment type and component
3. The component weight and geometry
4. Whether the component is ferrous
5. The work method currently in use
6. The frequency of the task
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CHAPTER 10 OF 22

Hot Strip Mill

This chapter identifies typical manual hand exposure scenarios encountered in this department of an integrated steel plant and highlights representative PSC application solutions commonly used for similar industrial tasks. Final product selection should always consider the specific task, component geometry, operating environment and site risk assessment.

1 DEPARTMENT OVERVIEW

Facilitator opening: Ask the audience how many roll changes their HSM makes per week across all stands — roughing, finishing, and edger. The typical answer is twenty to sixty or more, depending on campaign length and grade mix. Then ask how many of those roll changes have a documented task-level hand position analysis. That gap — between the volume of the task and the depth of analysis — is the starting point for this chapter. No other maintenance activity in the hot strip mill is performed as frequently, and no other activity generates as many hand injuries.

The Hot Strip Mill reduces reheated slabs from furnace discharge thickness — typically 200–250 mm — to finished strip thickness of 1.5–25 mm through a sequence of rolling passes in roughing and finishing stands. The slab passes through a scale breaker and primary descaler, then through a reversing rougher or a series of roughing stands where it is reduced to a transfer bar. The transfer bar passes through the finishing mill — a tandem arrangement of typically five to seven four-high stands — and exits as a continuous strip at rolling speed. The strip is then cooled on the run-out table and coiled on a down-coiler.

From a hand safety perspective, the HSM is one of the most demanding departments in the integrated plant. The volume of roll changes, the weight and heat of roll assemblies, the speed of entry table and guide maintenance, the coiler mandrel and wrapper roll work, and the routine maintenance of hydraulic systems and loopers all generate frequent, high-consequence hand exposure. The department operates continuously and maintenance is performed under significant production pressure.

2 MAJOR EQUIPMENT — SIX ZONES

SCALE BREAKER & DESCALER

High-pressure water descaling removes surface scale from the slab before rolling. Scale breaker rolls, headers, nozzle bars, and guide tables require maintenance. High-pressure water pipework and nozzle connections are accessed for blockage clearing and replacement.

ROUGHING MILL (REVERSING / TANDEM)

One or more reversing four-high or two-high roughing stands reduce the slab to transfer bar thickness. Work rolls, backup rolls, roll chocks, side guides, and edger rolls are changed frequently. Hydraulic cylinder systems, roll bending systems, and screwdown mechanisms require periodic maintenance.

TRANSFER BAR TABLE & CROP SHEAR

Roller table transports the transfer bar between roughing and finishing mills. The crop shear trims the head and tail end of the bar before it enters the finishing mill. Shear blades, table rollers, guide systems, and loop table components require maintenance.

FINISHING MILL (F1–F7)

Tandem four-high finishing stands perform the final reduction passes to finished strip thickness. Work roll changes occur multiple times per shift. Backup roll changes occur weekly or longer. Roll chocks, work roll bending systems, strip guides, loopers, and AGC cylinder systems require routine maintenance.

RUN-OUT TABLE & LAMINAR COOLING

Driven roller table transports the finished strip from the finishing mill exit to the coiler. Laminar cooling headers above and below the table cool the strip to coiling temperature. Table roller drives, coupling guards, cooling header nozzles, and water supply systems require maintenance.

DOWN-COILER & MANDREL

WRAPPER ROLLS & PINCH ROLL

The down-coiler winds the finished strip onto the mandrel. Wrapper rolls, pinch roll, and mandrel segments are subject to wear and require replacement. Coil transfer cars and coil tilters involve large heavy coil movements in the coiler bay.

3 MANUAL TASKS & HAND EXPOSURE SCENARIOS

ZONE A — SCALE BREAKER · ROUGHING MILL · EDGER

• HIGH · EXPOSURE FREQUENCY

Roughing Mill — Work Roll Change & Chock Handling

CRUSH / BURNS / STRUCK-BY

WHY THE HAND IS THERE

Roughing work rolls are changed on a campaign basis and when surface damage occurs. The roll and chock assembly — weighing several tonnes — is extracted by crane and a new assembly inserted. Workers guide the roll assembly during crane approach, engage the chock in the mill housing windows, and align coupling spindles — all in a hot, greasy environment with heavy moving masses.

HAND INTERFACE

Roll chock body during crane guidance, coupling spindle end, housing window ledge, chock locking key and bolt, crane hook at chock lifting lug

EXPOSURE TYPE

Hand crushed between chock and housing window during approach; burns from residual heat on roll and chock surfaces; struck-by if crane hook shifts during guidance

"During roughing work roll insertion, how is the chock guided into the housing window — and at what point in the approach is the worker's hand between the chock body and the housing?"

ENGINEERING INTERFACE CONSIDERATION

Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.

• HIGH · EXPOSURE FREQUENCY

Roughing Mill — Coupling Spindle Alignment & Pin Work

CRUSH / PINCH / IMPACT

WHY THE HAND IS THERE

After roll insertion, the drive coupling spindle must be engaged with the roll neck coupling. This requires aligning the spindle and roll coupling halves and inserting the coupling key or pin — by hand, in the narrow space between the mill housing and the spindle guard, with the spindle at rest but the coupling still subject to spring-back if alignment is released.

HAND INTERFACE

Coupling pin body, spindle coupling half face, keyway slot, coupling guard edge, roll neck end

EXPOSURE TYPE

Crush between coupling halves if alignment shifts; impact from coupling pin hammer-driving; pinch at keyway during key insertion; hand struck by spanner slip on tight fastener

"When the drive spindle is engaged with the new roll coupling, what keeps the coupling halves aligned during pin insertion — and is the holding hand in the strike zone when the pin is driven?"

ENGINEERING INTERFACE CONSIDERATION

Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.

• HIGH · EXPOSURE FREQUENCY

Descaler — Nozzle Bar & High-pressure Hose Maintenance

LINE-OF-FIRE / PINCH

WHY THE HAND IS THERE

Descaler nozzle bars and high-pressure water hose connections require regular maintenance. Nozzles block with scale and must be cleared or replaced. Hose connections at the nozzle bar and manifold require tightening and periodic replacement. Workers access nozzle bars through the descaler housing — where plant procedures permit — with the system isolated but residual pressure possible if isolation is incomplete.

HAND INTERFACE

Nozzle body and seat, high-pressure hose end fitting, manifold connection, nozzle bar mounting bracket

EXPOSURE TYPE

Hand in line of fire of residual pressurised water if isolation is incomplete; pinch between nozzle bar and housing during access; laceration on scale-contaminated nozzle edges

"When a descaler nozzle is replaced, what confirms that pressure in that nozzle bar section is fully relieved — and is that confirmation made by physical check or by procedure alone?"

ENGINEERING INTERFACE CONSIDERATION

Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.

ZONE B — FINISHING MILL (F1-F7)

• HIGH · EXPOSURE FREQUENCY

Finishing Mill — Work Roll Change (All Stands)

CRUSH / BURNS

WHY THE HAND IS THERE

Finishing work roll changes occur multiple times per shift at every stand across a full HSM campaign. The roll-and-chock assembly is extracted by roll change car and a pre-prepared assembly inserted. Workers guide the incoming assembly into the housing window, engage the coupling spindle, and fit the chock locking system — at each of the five to seven finishing stands, in sequence, under shift-change time pressure.

HAND INTERFACE

Roll chock body during car positioning, coupling spindle, chock locking wedge and bolt, housing window ledge, work roll bending block

EXPOSURE TYPE

Hand crushed between chock and housing window during final approach; burns from hot roll and chock; hand struck if roll change car reversal causes unexpected movement

"During a finishing stand work roll change, which part of the sequence puts the worker's hand closest to the nip between the incoming chock and the housing — and is that the step where the most injuries in this area occur?"

ENGINEERING INTERFACE CONSIDERATION

Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.

• MEDIUM · EXPOSURE FREQUENCY

Finishing Mill — Strip Guide & Side Guide Adjustment

PINCH / CAUGHT-BETWEEN

WHY THE HAND IS THERE

Inter-stand strip guides and side guides must be adjusted between roll changes and when strip threading problems occur. Workers reach between and behind the stands to adjust guide position, tighten guide mounting bolts, and replace worn guide liners — with the adjacent stand rolls in close proximity and hydraulic actuators potentially live.

HAND INTERFACE

Strip guide body and liner, side guide adjusting screw, guide mounting bolt, guide actuator arm, stand housing

EXPOSURE TYPE

Hand caught between guide and stand housing during reach-in adjustment; pinch at guide actuator during manual positioning; pinch on liner retaining bolt during replacement

"When an inter-stand strip guide is adjusted by hand between finishing stands, what confirms that the hydraulic guide actuator is de-energised and cannot move the guide while the adjustment is made?"

ENGINEERING INTERFACE CONSIDERATION

Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.

• MEDIUM · EXPOSURE FREQUENCY

Finishing Mill — Looper Roll & Arm Maintenance

CAUGHT-BETWEEN / CRUSH

WHY THE HAND IS THERE

Inter-stand loopers control strip tension between finishing stands. Looper rolls wear and require replacement; looper arms, pivot bearings, and hydraulic actuator connections require periodic maintenance. Workers access the looper mechanism in the confined space between stands — with the looper actuator and the adjacent stand rolls close by.

HAND INTERFACE

Looper roll body and shaft end, looper arm pivot, hydraulic actuator clevis pin, looper roll bearing housing

EXPOSURE TYPE

Hand caught between looper arm and stand housing if arm moves during maintenance; crush at clevis pin during actuator connection; pinch at roll bearing housing during roll change

"When looper roll maintenance is carried out between finishing stands, what prevents the looper actuator from energising and moving the arm while hands are on the looper roll or arm pivot?"

ENGINEERING INTERFACE CONSIDERATION

Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.

ZONE C — CROP SHEAR · RUN-OUT TABLE · LAMINAR COOLING · COILER

• MEDIUM · EXPOSURE FREQUENCY

Crop Shear — Blade Change & Guide Maintenance

CRUSH / LACERATION

WHY THE HAND IS THERE

Crop shear blades wear and chip and must be changed periodically. Blade change requires manual handling of heavy, sharp-edged blade segments in the confined shear body. Entry guides and side guides at the crop shear require adjustment and liner replacement — in close proximity to the blade holder and the shear drive mechanism.

HAND INTERFACE

Shear blade edge and mounting face, blade holder clamp, guide liner, shear body interior, mounting bolt

EXPOSURE TYPE

Laceration from blade edge during handling; hand crushed between blade and holder during clamping; pinch at guide liner retaining bolt during replacement

"During crop shear blade replacement, how is the blade segment held in position in the blade holder while the clamping bolts are engaged — and where is the holding hand relative to the blade edge at that moment?"

ENGINEERING INTERFACE CONSIDERATION

Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.

• HIGH · EXPOSURE FREQUENCY

Run-out Table — Roller Drive Coupling & Guard Maintenance

CAUGHT-BETWEEN / CRUSH

WHY THE HAND IS THERE

The run-out table has hundreds of individual roller drives connected through couplings and protected by coupling guards. Worn couplings, failed guards, and damaged roller ends require regular maintenance. Workers access coupling pins and guards in a linear arrangement with hot strip moving on adjacent rollers and drives potentially energized in adjacent sections.

HAND INTERFACE

Coupling pin and half, coupling guard fixing bolt, roller end bearing housing, drive shaft, guard mounting bracket

EXPOSURE TYPE

Hand caught between coupling halves if adjacent drive restarts; crush at coupling guard during refitting; hand struck on coupling pin during removal under spring tension

"On the run-out table, when a coupling guard is removed for maintenance, what is the isolation scope — is the specific roller isolated, the table section, or the entire table — and how is that scope confirmed?"

ENGINEERING INTERFACE CONSIDERATION

Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.

• HIGH · EXPOSURE FREQUENCY

Down-coiler — Wrapper Roll & Mandrel Segment Replacement

CRUSH / BURNS / PINCH

WHY THE HAND IS THERE

Wrapper rolls and mandrel segments in the coiler wear from contact with the hot strip and require regular replacement. Wrapper roll change requires manual handling of the roll body in the confined coiler housing; mandrel segment removal requires access inside the mandrel structure. Both tasks are performed in a hot environment with the adjacent pinch roll and strip guide in close proximity.

HAND INTERFACE

Wrapper roll body and shaft end, mandrel segment face and locking key, coiler housing interior, mounting bolt, pinch roll guide edge

EXPOSURE TYPE

Hand crushed between wrapper roll and coiler housing during removal; burns from hot roll surfaces; pinch at mandrel segment locking key during extraction

"During wrapper roll replacement in the coiler, how is the roll body supported during extraction from the housing — and at what point in that sequence does the worker's hand contact the roll body directly?"

ENGINEERING INTERFACE CONSIDERATION

Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.

ZONE D — BACKUP ROLLS · LAMINAR COOLING · HYDRAULIC SYSTEMS

• LOW · EXPOSURE FREQUENCY

Finishing Mill — Backup Roll Change (All Stands)

CRUSH / STRUCK-BY

WHY THE HAND IS THERE

Backup rolls are changed less frequently than work rolls — weekly to monthly — but they are significantly heavier and the change is more complex. The backup roll and chock assembly is extracted by crane and a pre-ground assembly inserted. Workers guide the massive assembly during crane approach, align the chock in the housing window, and engage locking systems in a confined mill aisle with very limited clearance.

HAND INTERFACE

Backup roll chock body during crane guidance, housing window ledge, chock locking wedge and cylinder, crane hook and tagline attachment

EXPOSURE TYPE

Hand crushed between massive chock and housing window if guidance fails; struck-by if crane hook or sling shifts during multi-tonne approach; pinch at locking wedge during engagement

"During a backup roll change, how many workers guide the incoming chock into the housing window — and what method keeps their hands outside the pinch zone between the chock and the housing?"

ENGINEERING INTERFACE CONSIDERATION

Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.

• HIGH · EXPOSURE FREQUENCY

Laminar Cooling — Header Nozzle & Water Connection Maintenance

LINE-OF-FIRE / PINCH

WHY THE HAND IS THERE

Laminar cooling headers above and below the run-out table deliver controlled water flow to cool the strip. Nozzle tubes block with scale and oxide deposits and must be cleared or replaced. Header water supply connections and isolation valves require maintenance. Workers reach between and beneath the roller table to access headers and nozzles — where plant procedures permit — with hot strip moving on adjacent rollers.

HAND INTERFACE

Nozzle tube body, header pipe fitting, isolation valve handle, water connection coupling

EXPOSURE TYPE

Hand in line of fire of pressurised water if isolation is incomplete; pinch between nozzle and header during replacement; burns from hot header pipe surface

"When a laminar cooling nozzle tube is replaced on the run-out table, at what point in the process is the header confirmed isolated — and what confirms it is at zero pressure before the nozzle is removed?"

ENGINEERING INTERFACE CONSIDERATION

Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.

• MEDIUM · EXPOSURE FREQUENCY

Mill Hydraulic Systems — Cylinder & Hose Maintenance

LINE-OF-FIRE / PINCH

WHY THE HAND IS THERE

High-pressure hydraulic cylinders and hoses drive the AGC system, work roll bending, side guides, and loopers throughout the finishing mill. Hose failure and cylinder seal replacement are frequent maintenance events. Workers access hydraulic connections in confined spaces between stands, below the mill floor level, and in the mill cellar — with hydraulic systems at high pressure on adjacent circuits.

HAND INTERFACE

Hydraulic hose end fitting, cylinder port connection, isolation valve handle, hose clamp and retaining bracket

EXPOSURE TYPE

Hand in line of fire of high-pressure hydraulic injection if hose fitting is disturbed without full pressure isolation; pinch between hose and bracket during routing; crush if cylinder moves when seal is accessed

"When a hydraulic hose is replaced on an AGC or bending cylinder in the finishing mill, what confirms that the circuit — not just the local valve — is at zero pressure before the fitting is broken?"

ENGINEERING INTERFACE CONSIDERATION

Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.

4 SHUTDOWN & OVERHAUL — ADDITIONAL EXPOSURE

LOW exposure frequency refers to how often the hand is exposed in normal operations, not to the consequence if contact occurs. HSM annual shutdowns are among the most intensive maintenance campaigns in the integrated plant — large contractor workforces, 24-hour operations, and multiple simultaneous heavy lifts.

TASK	HAND EXPOSURE	FREQ.	EXPOSURE	PSC ENGINEERING INTERFACE PORTFOLIO
Mill housing replacement or realignment	Mill housing sections lifted by crane and guided onto the mill base; massive components with restricted working space in the mill aisle	LOW	CRUSH	PSC Load Control Interfaces · PSC Position & Reach Interfaces
Spindle and coupling overhaul	Drive spindles and couplings removed from stands for grinding and re-bushing; heavy spindle assemblies handled by crane in the spindle bay	LOW	CRUSH / PINCH	PSC Load Control Interfaces · PSC Striking & Alignment Interfaces
Coiler mandrel full replacement	Mandrel assembly lifted by crane and guided into coiler housing; workers guide in confined coiler bay with adjacent pinch roll mechanism	LOW	CRUSH	PSC Load Control Interfaces · PSC Position & Reach Interfaces
Run-out table roller replacement (multiple)	Bulk roller replacement across the full table length; individual rollers removed and replaced sequentially by two-person team	MED	CAUGHT-BETWEEN	PSC Magnetic Handling Interfaces · PSC Manual Lifting Interfaces · PSC Position & Reach Interfaces · PSC Striking & Alignment Interfaces

5 CONTRACTOR & MOBILE EQUIPMENT INTERFACES

ACTIVITY / EQUIPMENT	HAND EXPOSURE SCENARIO	EXPOSURE	PSC ENGINEERING INTERFACE PORTFOLIO
Roll change contractor / crew	Work roll changes at finishing stands — the highest-volume repetitive crane and coupling task in the HSM; performed multiple times per shift	CRUSH BURNS	PSC Load Control Interfaces · PSC Position & Reach Interfaces
Overhead crane (mill aisle)	Roll and backup roll crane operations throughout the mill aisle; workers guide massive assemblies into housing windows at every stand	LINE-OF-FIRE	PSC Load Control Interfaces · PSC Position & Reach Interfaces
Mobile crane (outdoor / shutdown)	Lifting mill housings, spindles, and structural equipment during annual shutdown; large lifts with restricted yard space	CRUSH	PSC Load Control Interfaces · PSC Position & Reach Interfaces

6 HOT STRIP MILL QUICK ASSESSMENT CHECKLIST

Use during a plant walkdown or shutdown planning session. Answer based on current observed practice.

- ☐ During roughing work roll insertion by crane, does guidance of the chock into the housing window involve hand contact with the chock body or the housing face?
- ☐ When drive coupling pins are inserted or removed at roughing or finishing stands, is the holding hand in the strike zone during pin driving?
- ☐ When descaler nozzles are replaced, is pressure relief of the local nozzle bar confirmed by physical check before the nozzle is removed?
- ☐ During finishing work roll changes, at which step in the chock-into-window sequence is the worker's hand closest to the pinch zone?
- ☐ When inter-stand strip guides are adjusted by hand, is the hydraulic guide actuator confirmed de-energised before hands enter the inter-stand space?
- ☐ During looper roll maintenance between finishing stands, is the looper actuator positively isolated against movement while hands are on the looper arm or roll?
- ☐ During crop shear blade change, how is the blade segment held in the holder while clamping bolts are engaged — and where is the holding hand relative to the blade edge?
- ☐ During run-out table coupling guard maintenance, is the specific roller drive isolated — not just the table panel — before the guard is removed?
- ☐ During wrapper roll replacement in the coiler, does the worker's hand contact the roll body directly during extraction from the housing?
- ☐ During backup roll changes, are anti-tangle taglines used throughout the full housing window approach and seating sequence?
- ☐ During laminar cooling or hydraulic system maintenance, is zero-pressure confirmation made at the work point — not only at the isolation panel?

If you answered **Yes** to any of the above, PSC can review those tasks and recommend representative hands-free engineered interfaces to consider. Contact Shivani at **+91-96031-66448** or **sales@pschandsafety.com**

7 PSC ENGINEERING INTERFACE PORTFOLIO — HOT STRIP MILL

The following PSC engineering interfaces are relevant to the hand exposure scenarios identified in this chapter. This table introduces PSC product families and their primary engineering functions. It does not map any product to a specific scenario or application.

PSC LOAD CONTROL INTERFACES		
PSC ENGINEERING INTERFACE	PRIMARY FUNCTION	REPRESENTATIVE PART NUMBERS
PSC LoadGuider® Anti-Tangle Tagline	Controls suspended loads from a safe distance during crane operations	PSC-LGTC-15 PSC-LGTC-20 PSC-LGTC-25 PSC-LGTC-30
PSC Guidelt® Safety Rigger Tagline	Provides a safe, reusable tagline interface for controlling suspended loads from a stand-off distance throughout the lifting operation	PSC-GISRT-10 PSC-GISRT-15
PSC RiggerMate® Hook	Positions slings, shackles and rigging components without direct hand contact on rigging	PSC-RMH
PSC TaglineRetriever	Retrieves tagline rope ends after load landing without the operator entering the load zone	PSC-TRT PSC-TRT-3P
PSC POSITION & REACH INTERFACES		
PSC ENGINEERING INTERFACE	PRIMARY FUNCTION	REPRESENTATIVE PART NUMBERS
PSC LoadGuider® Push/Pull Pole	Pushes and pulls loads, components and rigging at a safe standoff distance	PSC-LG-42 PSC-LG-50 PSC-LG-72 PSC-LG-96
PSC Guide-It® Push/Pull Pole	Heavy-duty extended-reach push/pull for higher-force load guidance and positioning	PSC-GIT-50 PSC-GIT-72 PSC-GIT-96
PSC Load-It® Push/Pull Tool	Positions, guides and controls components using interchangeable heads suited to specific load geometries	PSC-LIT-S004 PSC-LIT-S006 PSC-LIT-S008
PSC SafeGuider Tool	Provides controlled standoff access to confined, hot or hazardous locations during maintenance	PSC-STGT-36 PSC-STGT-48
PSC MANUAL LIFTING INTERFACES		
PSC ENGINEERING INTERFACE	PRIMARY FUNCTION	REPRESENTATIVE PART NUMBERS
PSC Lift Assist Sling — Single Handle	Provides an engineered carry interface for components without a designed grip point, within manual handling limits	HSF-SH-075
PSC Lift Assist Sling — Double Handle	Provides a two-person engineered carry interface for longer components, within manual handling limits	HSF-DH-100
PSC Lift Assist Sling — Valve & Motor	Provides an engineered carry interface for valves, small motors and small pump bodies	HSF-CV
PSC Handle-Tech Pipe Lifter	Provides an engineered grip interface for pipe and hose carry without barrel gripping or finger-beneath-pipe contact	PSC-HTL-002 PSC-HTL-004 PSC-HTL-006
PSC EzyLift Pipe Lifting Tool	Provides a wrist-neutral lift interface for pipe and bar sections from floor or rack surfaces	PSC-EZYLFT

PSC Engineering Interface Portfolio — continued

PSC STRIKING & ALIGNMENT INTERFACES		
PSC ENGINEERING INTERFACE	PRIMARY FUNCTION	REPRESENTATIVE PART NUMBERS
PSC FingerSaver®	Holds slogging spanners, drifts, chisels and punches during hammer striking, keeping the holding hand outside the impact zone	PSC-FS-295 PSC-FS-375 PSC-FS-850
PSC Chisel & Punch Holder	Holds narrow chisels and punches during light hammer striking where a smaller holding interface is required	PSC-CPH

PSC MAGNETIC HANDLING INTERFACES		
PSC ENGINEERING INTERFACE	PRIMARY FUNCTION	REPRESENTATIVE PART NUMBERS
PSC Magnetic Lifter — Standard	Lifts and retrieves ferrous components from surfaces without fingers beneath the load	HSF-MG004 HSF-MG005
PSC MagHead Lifter	Retrieves ferrous components from confined or restricted locations with 360°/180° articulation	HSF-LG-001
PSC Magnetic Hand Lifter	Retrieves small ferrous components, sheet metal and freshly cut plate from surfaces	HSF-LG-MHL
PSC Multi-Grab Magnetic Handler	Handles individual ferrous components on workshop floors and decks with 360° rotation and lever release	MG004

Selection of the appropriate engineering interface depends on the specific application, load characteristics, work method and site conditions. **Contact PSC Hand Safety India for application-specific engineering guidance and product recommendations.**

— APPLICATION-SPECIFIC ENGINEERING GUIDANCE

If any hand exposure scenario in this chapter reflects tasks in your plant or maintenance team, PSC Hand Safety India can provide application-specific engineering guidance. Bring the task, the component, the work method, and the site conditions — PSC will identify the most appropriate engineering interface for your specific application.

TO RECEIVE APPLICATION-SPECIFIC GUIDANCE, DESCRIBE:

1. The specific task or operation
2. The equipment type and component
3. The component weight and geometry
4. Whether the component is ferrous
5. The work method currently in use
6. The frequency of the task
7. The working environment and access constraints
8. Your plant name and location

ENGINEERING GUIDANCE

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Chapter 10 of 22 · Version 2

ENGINEER THE HAND OUT OF THE HAZARD™

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Plate Mill

This chapter identifies typical manual hand exposure scenarios encountered in this department of an integrated steel plant and highlights representative PSC application solutions commonly used for similar industrial tasks. Final product selection should always consider the specific task, component geometry, operating environment and site risk assessment.

1 DEPARTMENT OVERVIEW

Facilitator opening: Ask the audience what is the heaviest single item a maintenance worker in their plate mill handles by hand — without a crane or mechanical aid. In most plate mills, the answer involves a shear blade segment, a leveller roll, a transfer table roller, or a guide assembly. Then ask whether any of those tasks has a documented hand position requirement. The plate mill differs from the strip mill in one critical respect: the product is heavy, short, and flat — and the maintenance equipment that handles it reflects those same characteristics. That is the starting point for this chapter.

The Plate Mill rolls reheated slabs into heavy steel plates — typically 5–150 mm thick and 1–5 m wide — used in structural, pressure vessel, shipbuilding, and pipeline applications. The slab passes through a primary descaler and then through a reversing four-high or two-high mill stand where it is rolled in multiple passes, edged by vertical edger rolls, and then directed to a hot leveller, cooling bed, shear line, and inspection area. Plates are marked, stacked, and transferred to storage or despatch.

From a hand safety perspective, the plate mill has a different character from the HSM. The product is heavier and moves more slowly; the maintenance tasks involve larger, heavier individual components with less mechanisation than the strip mill; and the finishing end — shear line, leveller, cooling bed, stacker, and transfer tables — concentrates a high density of hand exposure scenarios involving heavy plate and structural steel components. The crane dependency throughout the plate mill is extremely high.

2 MAJOR EQUIPMENT

REVERSING MILL STAND & EDGER

A four-high or two-high reversing stand performs all rolling passes on the plate. The edger stand controls plate width. Work rolls, backup rolls, edger rolls, and all associated chocks, couplings, and guide systems are changed and maintained on a campaign basis — with the same pinch and crush hazards as the HSM but with heavier, less-guided components.

HOT LEVELLER

Corrects flatness defects in the plate after rolling using a set of driven upper and lower levelling rolls. Leveller rolls, bearings, and the roll gap adjustment mechanism require maintenance. Workers access leveller roll ends and bearing housings in a hot, confined space between the upper and lower roll frames.

COOLING BED

Heavy plates are transferred to a cooling bed — typically a walking beam or skid type — where they cool before entering the shear line. Cooling bed beams, skid rails, drive chains, and transfer table rollers require maintenance with the same manual handling demands as the sinter plant cooling section — but with much heavier individual components.

CROP & SIDE SHEAR

Shear lines trim plate head, tail, and edges to size. Shear blades — heavy, precise, and sharp-edged — must be changed when worn. Side trimmer blades, hold-down roll assemblies, and guide systems also require regular maintenance in the shear area.

PLATE STACKER & TRANSFER TABLES

Cut plates are lifted, stacked, and transferred by plate stackers, magnetic lifters, and roller transfer tables. Stacker arms, magnetic pad assemblies, roller table drives, and transfer car mechanisms require maintenance — with heavy plate moving in close proximity during production.

ROLLER TABLES (ENTRY, EXIT & TRANSFER)

Driven roller tables transport the plate between all process steps throughout the plate mill. Rollers, drive couplings, guards, and table frame components require the same maintenance as the HSM run-out table — at a larger scale and with heavier individual components.

3 MANUAL TASKS & HAND EXPOSURE SCENARIOS

ZONE A — MILL STAND · EDGER · DESCALER

• HIGH · EXPOSURE FREQUENCY

Mill Stand — Work Roll Change & Chock Guidance

CRUSH / BURNS

WHY THE HAND IS THERE

Plate mill work roll changes share the same character as the HSM — crane extraction and insertion of the roll-and-chock assembly, coupling spindle engagement, and chock locking. The plate mill difference is that the mill reverses and the work is less automated — roll change cars may not be present, increasing the reliance on crane guidance with direct hand involvement at the housing window.

HAND INTERFACE

Roll chock body during crane guidance, coupling spindle end, housing window ledge, chock locking key, crane hook at chock lifting lug

EXPOSURE TYPE

Hand crushed between chock and housing window during crane approach; burns from residual heat on roll and chock; struck-by if crane hook shifts at chock lug

"In the plate mill — where roll change cars may not be present — how is the chock guided into the housing window during crane insertion, and who controls the crane during that final approach?"

ENGINEERING INTERFACE CONSIDERATION

Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.

• MEDIUM · EXPOSURE FREQUENCY

Edger Roll — Change & Guide Adjustment

CRUSH / PINCH

WHY THE HAND IS THERE

Vertical edger rolls and their chocks are changed when worn. Side guides around the edger require adjustment between rolling campaigns. The edger stand is more confined than the main mill — chock guidance requires the hand to be in a narrower space during crane approach, and guide bolts are accessed from above with the plate entry area directly below.

HAND INTERFACE

Edger roll chock during crane approach, side guide body and adjusting screw, guide mounting bolt, edger stand housing

EXPOSURE TYPE

Hand crushed between chock and edger housing in confined stand; pinch at side guide adjusting screw; struck-by from unexpected edger drive movement if not fully isolated

"During edger roll chock guidance into the edger housing, how much clearance exists between the chock body and the housing face — and is the edger drive confirmed isolated before any hand enters that space?"

ENGINEERING INTERFACE CONSIDERATION

Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.

• MEDIUM · EXPOSURE FREQUENCY

Hot Leveller — Roll & Bearing Maintenance

CRUSH / BURNS / PINCH

WHY THE HAND IS THERE

Leveller rolls wear from contact with hot plate surfaces and require replacement. Bearing housings at the roll ends are accessed for inspection and replacement between campaigns. The leveller is a confined machine — the upper and lower roll frames limit access, and bearing housing work requires the hand to enter the space between roll frames.

HAND INTERFACE

Leveller roll body and shaft end, bearing housing face and retaining bolt, upper roll frame edge, roll gap adjustment screw

EXPOSURE TYPE

Hand crushed between bearing housing and roll frame; burns from residual heat on roll and frame surfaces; pinch at roll gap adjustment mechanism during setting

"During leveller roll bearing replacement, what confirms that both the upper and lower roll drive systems are positively isolated before hands enter the space between the roll frames?"

ENGINEERING INTERFACE CONSIDERATION

Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.

ZONE B — SHEAR LINE · COOLING BED · STACKER

• MEDIUM · EXPOSURE FREQUENCY

Crop & Side Shear — Blade Change

CRUSH / LACERATION

WHY THE HAND IS THERE

Shear blades in the plate mill are significantly heavier than those in the strip crop shear — individual blade segments may weigh 200–600 kg and require crane handling. Workers guide the blade segment into the blade holder by crane, align it against the holder face, and engage the clamping bolts. The blade edge is extremely sharp and the holder space is confined.

HAND INTERFACE

Blade segment body and edge during crane guidance, blade holder clamping face, clamping bolt, crane hook at blade lifting point

EXPOSURE TYPE

Laceration if blade edge contacts hand during crane approach; hand crushed between blade and holder during clamping; struck-by if crane hook shifts during the approach

"During plate shear blade installation by crane, at what point in the approach does the worker's hand first contact the blade body or the blade holder — and what tool or method is used to guide the blade into position?"

ENGINEERING INTERFACE CONSIDERATION

Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.

• HIGH · EXPOSURE FREQUENCY

Cooling Bed — Beam, Skid & Drive Chain Maintenance

CRUSH / BURNS / CAUGHT-BETWEEN

WHY THE HAND IS THERE

Cooling bed walking beams, skid rails, and drive chains require maintenance analogous to the sinter plant cooler — but at a much larger scale, with individual steel plate weights of 5–30 tonnes moving above the maintenance area. Chain link pins, sprocket teeth, and beam drive coupling components are the primary hand contact points.

HAND INTERFACE

Chain link and pin, sprocket tooth face, beam drive coupling, skid rail surface, drive shaft flange

EXPOSURE TYPE

Hand caught between chain and sprocket during link work; crush at drive coupling during pin insertion; burns from hot skid surface; hand in line of fire of beam movement if drive is not fully isolated

"During cooling bed drive chain maintenance, what prevents the walking beam drive from cycling while chain link pins are being inserted or removed — and is that confirmed by the maintenance crew or assumed from the production stop?"

ENGINEERING INTERFACE CONSIDERATION

Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.

• HIGH · EXPOSURE FREQUENCY

Roller Table — Roller, Coupling & Guard Maintenance

CAUGHT-BETWEEN / CRUSH

WHY THE HAND IS THERE

Plate mill roller tables handle heavier product than the HSM run-out table. Individual roller assemblies — larger diameter and heavier — require crane-assisted replacement. Coupling pin work, guard removal and replacement, and roller end-bearing inspection follow the same pattern as the HSM but with less installed automation and heavier individual components.

HAND INTERFACE

Roller coupling pin and half, coupling guard fixing bolt, roller end bearing housing, crane hook at roller lifting point

EXPOSURE TYPE

Hand caught between coupling halves if adjacent drive restarts; crush at coupling guard during refitting; hand struck by coupling pin under spring tension during removal

"On the plate mill roller table, when a coupling pin is removed for a roller change, how is that specific roller confirmed isolated from adjacent rollers that may still be live?"

ENGINEERING INTERFACE CONSIDERATION

Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.

ZONE C — STACKER · TRANSFER TABLES · HYDRAULICS

• HIGH · EXPOSURE FREQUENCY

Plate Stacker — Arm, Magnetic Pad & Guide Maintenance

CRUSH / LINE-OF-FIRE

WHY THE HAND IS THERE

Plate stackers use magnetic lifting pads or mechanical grabs to lift and stack cut plates. Magnetic pad assemblies, stacker arms, guide rails, and the stacker traverse mechanism require maintenance. Workers access these components in a bay where heavy plates are moved overhead at every stacking cycle — one of the highest line-of-fire risks in the plate mill finishing section.

HAND INTERFACE

Magnetic pad face and connection cable, stacker arm pivot, guide rail and carriage, traverse drive coupling, stacker frame

EXPOSURE TYPE

Hand in line of fire of stacker arm movement during maintenance if traverse is not positively isolated; crush between stacker arm and guide rail during adjustment; hand struck by unexpected stacker traverse

"When stacker magnetic pad maintenance is carried out, what isolates the stacker traverse drive — and is that isolation confirmed before any hand enters the stacker arm movement zone?"

ENGINEERING INTERFACE CONSIDERATION

Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.

• MEDIUM · EXPOSURE FREQUENCY

Transfer Table — Alignment, Roller & Drive Maintenance

CAUGHT-BETWEEN / CRUSH

WHY THE HAND IS THERE

Plate transfer tables shuttle plates laterally between roller table lines. Table rollers, drive couplings, lateral drive mechanisms, and table alignment guides require maintenance. The table drives operate as a cross-drive to the main rolling direction — workers often misidentify which drive is active during maintenance and approach the coupling zone of a live adjacent drive.

HAND INTERFACE

Transfer table roller coupling, lateral drive shaft, alignment guide bolt, table frame, coupling guard

EXPOSURE TYPE

Hand caught between coupling halves if the lateral or longitudinal drive restarts; crush at table frame during alignment; pinch at alignment guide adjusting bolt

"On the plate transfer table, when maintenance is carried out on a single roller or coupling, what isolation covers both the lateral shuttle drive and the longitudinal roller drive — and are both confirmed before work begins?"

ENGINEERING INTERFACE CONSIDERATION

Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.

• MEDIUM · EXPOSURE FREQUENCY

Hydraulic Cylinder & Guide System — Maintenance

LINE-OF-FIRE / PINCH

WHY THE HAND IS THERE

Hydraulic cylinders operate the leveller gap, shear hold-down, and plate guide systems throughout the plate mill. Cylinder seal replacement, hose connection maintenance, and guide system adjustment involve hand access to hydraulic connections in confined spaces — with adjacent cylinders potentially live on the same circuit.

HAND INTERFACE

Hydraulic hose end fitting, cylinder port connection, guide adjusting bolt, isolation valve handle

EXPOSURE TYPE

Hand in line of fire of high-pressure hydraulic injection if circuit is not fully isolated; pinch between guide and cylinder during adjustment; crush if cylinder strokes during seal access

"When a hydraulic hose connection is broken for a guide cylinder replacement, what confirms the specific circuit — not just the machine — is at zero pressure before the fitting is disturbed?"

ENGINEERING INTERFACE CONSIDERATION

Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.

4 SHUTDOWN & OVERHAUL — ADDITIONAL EXPOSURE

LOW exposure frequency refers to how often the hand is exposed in normal operations, not to the consequence if contact occurs. Plate mill components are heavier than strip mill equivalents — crane dependency is extremely high throughout every shutdown task.

TASK	HAND EXPOSURE	FREQ.	EXPOSURE	PSC ENGINEERING INTERFACE PORTFOLIO
Backup roll change (mill stand)	Very heavy backup roll and chock assembly lifted by crane and guided into housing window; restricted working space in plate mill aisle	LOW	CRUSH	PSC Load Control Interfaces · PSC Position & Reach Interfaces
Leveller full roll set replacement	All leveller rolls changed by crane; workers guide each roll and bearing housing into the leveller frame in the confined inter-frame space	LOW	CRUSH / BURNS	PSC Load Control Interfaces · PSC Position & Reach Interfaces · PSC Striking & Alignment Interfaces
Shear frame structural inspection	Workers enter the shear body for structural inspection; confined space with blade edges and hold-down roll structures close to all movement paths	LOW	LACERATION / CRUSH	PSC Position & Reach Interfaces
Mill housing realignment / replacement	Mill housing sections lifted by crane; workers guide massive structures onto the mill base in the restricted mill aisle	LOW	CRUSH	PSC Load Control Interfaces · PSC Position & Reach Interfaces

5 CONTRACTOR & MOBILE EQUIPMENT INTERFACES

ACTIVITY / EQUIPMENT	HAND EXPOSURE SCENARIO	EXPOSURE	PSC ENGINEERING INTERFACE PORTFOLIO
Roll change crew	Work roll and edger roll changes throughout the plate mill campaign; crane-guided chock insertion without roll change cars in many plate mill configurations	CRUSH BURNS	PSC Load Control Interfaces · PSC Position & Reach Interfaces
Shear blade change crew	Heavy shear blade segment crane lifts and guidance into blade holder at the crop and side shear stations; high laceration and crush risk	CRUSH LACERATION	PSC Load Control Interfaces · PSC Position & Reach Interfaces
Overhead crane (mill & finishing)	All major component movements throughout the plate mill — rolls, blades, leveller rolls, housing sections; hand guidance at every landing	LINE-OF-FIRE	PSC Load Control Interfaces · PSC Position & Reach Interfaces

6 PLATE MILL QUICK ASSESSMENT CHECKLIST

Use during a plant walkdown or shutdown planning session. Answer based on current observed practice.

- ☐ During work roll chock guidance into the mill housing window, does the worker's hand contact the chock body or the housing face during the crane approach?
- ☐ During edger roll change, is the edger drive confirmed isolated before any hand enters the space between the chock and the edger housing?
- ☐ During leveller roll bearing replacement, are both the upper and lower roll drive systems positively isolated before hands enter the inter-frame space?
- ☐ During shear blade installation by crane, does the worker's hand contact the blade body or the blade holder before the blade is fully seated?
- ☐ During cooling bed chain link maintenance, is the walking beam drive confirmed isolated — not just stopped — before chain link pins are removed?
- ☐ When a roller table coupling pin is removed, is the specific roller drive isolated from adjacent rollers that may still be live?
- ☐ During plate stacker maintenance, is the stacker traverse drive positively isolated before any hand enters the stacker arm movement zone?
- ☐ On the plate transfer table, are both the lateral shuttle drive and the longitudinal roller drive confirmed isolated before coupling or guide work begins?
- ☐ When a hydraulic hose is disconnected for guide cylinder maintenance, is zero pressure confirmed at the work point — not only at the isolation panel?
- ☐ Are all mill stand and shear crane lifts controlled with anti-tangle taglines throughout the full landing sequence?

If you answered **Yes** to any of the above, PSC can review those tasks and recommend representative hands-free engineered interfaces to consider. Contact Shivani at **+91-96031-66448** or **sales@pschandsafety.com**

7 PSC ENGINEERING INTERFACE PORTFOLIO — PLATE MILL

The following PSC engineering interfaces are relevant to the hand exposure scenarios identified in this chapter. This table introduces PSC product families and their primary engineering functions. It does not map any product to a specific scenario or application.

PSC LOAD CONTROL INTERFACES		
PSC ENGINEERING INTERFACE	PRIMARY FUNCTION	REPRESENTATIVE PART NUMBERS
PSC LoadGuider® Anti-Tangle Tagline	Controls suspended loads from a safe distance during crane operations	PSC-LGTC-15 PSC-LGTC-20 PSC-LGTC-25 PSC-LGTC-30
PSC Guidelt® Safety Rigger Tagline	Provides a safe, reusable tagline interface for controlling suspended loads from a stand-off distance throughout the lifting operation	PSC-GISRT-10 PSC-GISRT-15
PSC RiggerMate® Hook	Positions slings, shackles and rigging components without direct hand contact on rigging	PSC-RMH
PSC TaglineRetriever	Retrieves tagline rope ends after load landing without the operator entering the load zone	PSC-TRT PSC-TRT-3P
PSC POSITION & REACH INTERFACES		
PSC ENGINEERING INTERFACE	PRIMARY FUNCTION	REPRESENTATIVE PART NUMBERS
PSC LoadGuider® Push/Pull Pole	Pushes and pulls loads, components and rigging at a safe standoff distance	PSC-LG-42 PSC-LG-50 PSC-LG-72 PSC-LG-96
PSC Guide-It® Push/Pull Pole	Heavy-duty extended-reach push/pull for higher-force load guidance and positioning	PSC-GIT-50 PSC-GIT-72 PSC-GIT-96
PSC Load-It® Push/Pull Tool	Positions, guides and controls components using interchangeable heads suited to specific load geometries	PSC-LIT-S004 PSC-LIT-S006 PSC-LIT-S008
PSC SafeGuider Tool	Provides controlled standoff access to confined, hot or hazardous locations during maintenance	PSC-STGT-36 PSC-STGT-48
PSC MANUAL LIFTING INTERFACES		
PSC ENGINEERING INTERFACE	PRIMARY FUNCTION	REPRESENTATIVE PART NUMBERS
PSC Lift Assist Sling — Single Handle	Provides an engineered carry interface for components without a designed grip point, within manual handling limits	HSF-SH-075
PSC Lift Assist Sling — Double Handle	Provides a two-person engineered carry interface for longer components, within manual handling limits	HSF-DH-100
PSC Lift Assist Sling — Valve & Motor	Provides an engineered carry interface for valves, small motors and small pump bodies	HSF-CV
PSC Handle-Tech Pipe Lifter	Provides an engineered grip interface for pipe and hose carry without barrel gripping or finger-beneath-pipe contact	PSC-HTL-002 PSC-HTL-004 PSC-HTL-006
PSC EzyLift Pipe Lifting Tool	Provides a wrist-neutral lift interface for pipe and bar sections from floor or rack surfaces	PSC-EZYLFT

PSC Engineering Interface Portfolio — continued

PSC STRIKING & ALIGNMENT INTERFACES		
PSC ENGINEERING INTERFACE	PRIMARY FUNCTION	REPRESENTATIVE PART NUMBERS
PSC FingerSaver®	Holds slogging spanners, drifts, chisels and punches during hammer striking, keeping the holding hand outside the impact zone	PSC-FS-295 PSC-FS-375 PSC-FS-850
PSC Chisel & Punch Holder	Holds narrow chisels and punches during light hammer striking where a smaller holding interface is required	PSC-CPH

PSC MAGNETIC HANDLING INTERFACES		
PSC ENGINEERING INTERFACE	PRIMARY FUNCTION	REPRESENTATIVE PART NUMBERS
PSC Magnetic Lifter — Standard	Lifts and retrieves ferrous components from surfaces without fingers beneath the load	HSF-MG004 HSF-MG005
PSC MagHead Lifter	Retrieves ferrous components from confined or restricted locations with 360°/180° articulation	HSF-LG-001
PSC Magnetic Hand Lifter	Retrieves small ferrous components, sheet metal and freshly cut plate from surfaces	HSF-LG-MHL
PSC Multi-Grab Magnetic Handler	Handles individual ferrous components on workshop floors and decks with 360° rotation and lever release	MG004

Selection of the appropriate engineering interface depends on the specific application, load characteristics, work method and site conditions. **Contact PSC Hand Safety India for application-specific engineering guidance and product recommendations.**

— APPLICATION-SPECIFIC ENGINEERING GUIDANCE

If any hand exposure scenario in this chapter reflects tasks in your plant or maintenance team, PSC Hand Safety India can provide application-specific engineering guidance. Bring the task, the component, the work method, and the site conditions — PSC will identify the most appropriate engineering interface for your specific application.

TO RECEIVE APPLICATION-SPECIFIC GUIDANCE, DESCRIBE:

1. The specific task or operation
2. The equipment type and component
3. The component weight and geometry
4. Whether the component is ferrous
5. The work method currently in use
6. The frequency of the task
7. The working environment and access constraints
8. Your plant name and location

ENGINEERING GUIDANCE

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CHAPTER 12 OF 22

Bar & Rod Mill

This chapter identifies typical manual hand exposure scenarios encountered in this department of an integrated steel plant and highlights representative PSC application solutions commonly used for similar industrial tasks. Final product selection should always consider the specific task, component geometry, operating environment and site risk assessment.

1 DEPARTMENT OVERVIEW

Facilitator opening: Ask the audience what the most common hand injury mechanism in their bar and rod mill is. In most plants the answer is one of three: a guide-setting hand caught in a pass during start-up, a coupling pin driven with the holding hand in the strike zone, or a hand caught in the cooling bed chain mechanism during maintenance. All three are well-known. All three continue to occur. The question for this chapter is not whether people know the hazard — it is whether the task procedure specifies what the hand must not do, and provides a tool that makes the safe method easier than the unsafe one.

The Bar and Rod Mill rolls reheated billets into long products — round bar, deformed bar, angle, channel, flat bar, and wire rod coils — at high rolling speeds. Billets from the reheating furnace enter a series of horizontal and vertical rolling stands arranged in roughing, intermediate, and finishing groups. The rolled product is then cooled on a cooling bed, cut to length by a cold shear or flying shear, collected into bundles, and transferred to the finishing bay for weighing, bundling, and despatch.

From a hand safety perspective, the bar and rod mill has a distinct character from the plate and strip mills. Rolling speeds are high; individual component weights in the rolling stands are lower than the heavy plate or strip mill; but the volume of guide changes, stand changes, and pinch roll maintenance tasks is very high — often performed under production pressure with limited mechanical aids. The cooling bed, chain transfer, and bundling equipment add further hand exposure at the finishing end.

2 MAJOR EQUIPMENT

ROLLING STANDS — ROUGHING, INTERMEDIATE & FINISHING

A series of two-high or three-high stands arranged in horizontal and vertical alternating sequence. Roll passes are cut into the roll barrel. Roll changes occur frequently. Guide boxes — entry and exit guides — are fitted to each stand and must be set precisely for each section and size rolled. Stand changes, roll changes, and guide changes are the primary hand exposure tasks.

GUIDE BOXES & TWIST GUIDES

Entry and exit guide boxes direct the bar into and out of each roll pass. Twist guides rotate the bar between passes for the correct entry orientation. Both require frequent adjustment and replacement. Guide setting — positioning the guide relative to the roll pass — involves the hand very close to the roll barrel and the guide entry throat.

FLYING SHEAR & COLD SHEAR

Flying shears cut the bar at rolling speed for cobble clearing and head/tail cropping. Cold shears cut the cooled bar to finished lengths. Shear blade replacement, hold-down roll maintenance, and guide work around the shear are the key hand exposure points.

PINCH ROLLS & LOOPERS

Pinch rolls control bar tension between stands and at the entry to the cooling bed. Loopers manage inter-stand tension on section and bar mills. Pinch roll surface wear, bearing maintenance, and looper roll replacement are frequent tasks with hand-in-nip exposure risk.

COOLING BED

The cooling bed — typically a walking rake or chain-driven raking type — receives the rolled bar from the run-out channel and advances it across the bed to the cold shear. Walking rake mechanisms, chain drives, and raking finger assemblies require maintenance with the same caught-between and crush hazards as the sinter and plate mill cooling beds.

CHAIN TRANSFER, BUNDLER & TYING MACHINE

Bar bundles are transferred from the cold shear by chain conveyors to the bundler and tying machine. Chain links, sprockets, bundle guide fingers, and tying wire mechanisms require maintenance. Tying wire and binding band are under tension and create laceration and struck-by risks during maintenance.

3 MANUAL TASKS & HAND EXPOSURE SCENARIOS

ZONE A — ROLLING STANDS · GUIDE BOXES · PINCH ROLLS

• HIGH · EXPOSURE FREQUENCY

Guide Box — Setting, Adjustment & Replacement

PINCH / CAUGHT-BETWEEN

WHY THE HAND IS THERE

Guide boxes must be set precisely relative to the roll pass at each stand change or size change. The guide entry throat is positioned close to the roll barrel. Workers adjust guide position by hand — tightening clamping bolts and verifying alignment — with the stand at rest but in a position where the roll gap is close to the guide entry, and restart could occur before the hand is withdrawn.

HAND INTERFACE

Guide box body and entry throat, clamping bolt head, guide mounting bracket, roll barrel surface nearby

EXPOSURE TYPE

Hand caught in guide throat if rolls move during setting; pinch between guide clamp and stand housing; hand struck by guide entry if bar entry is attempted before guide is confirmed set

"During guide box setting on a bar mill stand, how close does the worker's hand approach the roll pass — and what confirms that the roll drive is isolated before the hand enters the guide throat area?"

ENGINEERING INTERFACE CONSIDERATION

Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.

• HIGH · EXPOSURE FREQUENCY

Roll Change — Stand Roll & Coupling Pin Work

CRUSH / IMPACT / PINCH

WHY THE HAND IS THERE

Bar mill rolls are changed frequently as pass profiles wear. Roll extraction and insertion is typically done by overhead crane or manual roll change equipment. Coupling spindle engagement and coupling pin insertion follow the same pattern as the HSM — but with smaller, less automated equipment and higher change frequency, increasing cumulative exposure. Coupling pin work is the highest-frequency hammer-and-hold task in the bar mill.

HAND INTERFACE

Coupling pin body and head, spindle coupling half face, keyway slot, roll neck end, coupling guard edge

EXPOSURE TYPE

Crush between coupling halves if alignment shifts; impact from pin hammer-driving with holding hand in strike zone; pinch at keyway during key insertion

"On the bar mill, coupling pin changes occur many times per shift. Is the holding-hand position during pin driving specified in any task procedure — or is it left to the individual operator's practice?"

ENGINEERING INTERFACE CONSIDERATION

Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.

• HIGH · EXPOSURE FREQUENCY

Pinch Roll — Surface, Bearing & Drive Maintenance

CAUGHT-BETWEEN / PINCH

WHY THE HAND IS THERE

Pinch rolls controlling bar tension between stands and at the cooling bed entry wear rapidly and require frequent surface inspection, bearing checks, and periodic roll replacement. Workers access the pinch roll nip and bearing housings — with the roll pair presenting a continuous nip hazard even at rest if the roll drive is not positively isolated before access.

HAND INTERFACE

Pinch roll surface, roll nip zone, bearing housing and retaining bolt, roll drive coupling, adjusting screw

EXPOSURE TYPE

Hand drawn into roll nip during surface inspection if roll moves; pinch at bearing housing during replacement; caught-between at roll drive coupling if isolation is incomplete

"During pinch roll surface inspection, how close does the inspection hand approach the nip line — and is the roll drive positively isolated and mechanically prevented from rotating before inspection begins?"

ENGINEERING INTERFACE CONSIDERATION

Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.

ZONE B — FLYING SHEAR · COOLING BED · CHAIN TRANSFER & BUNDLER

• MEDIUM · EXPOSURE FREQUENCY

Flying Shear — Blade Change & Guide Maintenance

CRUSH / LACERATION

WHY THE HAND IS THERE

Flying shear blades chip and wear and must be replaced. The blade mounting in the rotating drum requires the hand to be positioned close to sharp blade edges during extraction and installation. Entry guide and deflector guide systems around the flying shear also require adjustment and liner replacement — with the shear drum in close proximity and the bar entry path below.

HAND INTERFACE

Shear blade edge and mounting face, blade clamping bolt, shear drum body, entry guide liner, deflector guide

EXPOSURE TYPE

Laceration from blade edge during installation; hand crushed between blade and drum face during clamping; pinch at entry guide adjustment in close proximity to drum

"During flying shear blade change, what confirms that the shear drum is mechanically locked against rotation — not just de-energised — before the blade clamping area is accessed?"

ENGINEERING INTERFACE CONSIDERATION

Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.

• HIGH · EXPOSURE FREQUENCY

Cooling Bed — Raking Finger, Chain & Drive Maintenance

CAUGHT-BETWEEN / CRUSH

WHY THE HAND IS THERE

Cooling bed raking fingers, drive chains, sprockets, and walking rake mechanisms require frequent maintenance. Chain link pins, broken raking fingers, and sprocket tooth wear are the most common failure modes. Workers access the chain and sprocket zone in a low, confined space beneath the cooling bed structure — with the drive chain and sprockets presenting an acute caught-between risk if the drive is not positively isolated.

HAND INTERFACE

Chain link and pin, sprocket tooth, raking finger body, drive shaft coupling, cooling bed frame

EXPOSURE TYPE

Hand caught between chain and sprocket during link pin work; crush at drive shaft coupling during pin insertion; struck-by if raking finger detaches during adjustment

"In the bar mill cooling bed, chain link pin work is one of the most common maintenance tasks. How is the chain held stationary during pin removal — and where is the worker's hand relative to the sprocket teeth during that operation?"

ENGINEERING INTERFACE CONSIDERATION

Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.

• MEDIUM · EXPOSURE FREQUENCY

Bundle Transfer Chain & Tying Machine — Maintenance

LACERATION / CAUGHT-BETWEEN

WHY THE HAND IS THERE

Chain transfer conveyors move bar bundles from the cold shear to the tying machine and to the weighing and despatch area. Tying wire and binding band mechanisms apply and tension binding wire around each bundle. Workers clear jams in the tying wire mechanism, replace worn chain links, and adjust bundle guide fingers — with tying wire under tension and binding band edges presenting laceration risk at every clearance intervention.

HAND INTERFACE

Tying wire end and binding band edge, chain link and pin, bundle guide finger, tying head mechanism, sprocket

EXPOSURE TYPE

Laceration from binding band and tying wire under tension during clearing; hand caught in tying head mechanism during jam clearing; caught-between at chain and sprocket during link maintenance

"When a jam in the tying wire mechanism is cleared by hand, is the tying head positively isolated before the operator's hand enters the mechanism — or is clearing done under tension with the machine in a stopped-but-energised state?"

ENGINEERING INTERFACE CONSIDERATION

Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.

4 SHUTDOWN & OVERHAUL — ADDITIONAL EXPOSURE

LOW exposure frequency refers to how often the hand is exposed in normal operations, not to the consequence if contact occurs. Bar mill shutdowns involve a large number of individual stand and guide changes across many stands simultaneously — cumulative hand exposure across the crew is high even when individual task frequency is moderate.

TASK	HAND EXPOSURE	FREQ.	EXPOSURE	PSC ENGINEERING INTERFACE PORTFOLIO
Full stand change (housing lift)	Rolling stand housing lifted by crane and guided onto the mill base; workers guide in confined mill floor aisle between adjacent live stands	LOW	CRUSH	PSC Load Control Interfaces · PSC Position & Reach Interfaces
Cooling bed full rake replacement	All raking finger assemblies replaced; repetitive chain link and finger bolt work along the full bed length during the campaign	LOW	CAUGHT-BETWEEN	PSC Position & Reach Interfaces · PSC Striking & Alignment Interfaces
Cold shear blade replacement	Heavy shear blade segments lifted and guided into the blade holder; laceration and crush risk during crane approach and clamping	MED	CRUSH / LACERATION	PSC Load Control Interfaces · PSC Position & Reach Interfaces · PSC Striking & Alignment Interfaces
Spindle and coupling overhaul	Drive spindles and couplings removed from stands for re-bushing; heavy spindles handled by crane in the mill aisle	LOW	CRUSH / PINCH	PSC Load Control Interfaces · PSC Striking & Alignment Interfaces

5 CONTRACTOR & MOBILE EQUIPMENT INTERFACES

ACTIVITY / EQUIPMENT	HAND EXPOSURE SCENARIO	EXPOSURE	PSC ENGINEERING INTERFACE PORTFOLIO
Guide & roll change crew	High-frequency guide box and roll change across all stands throughout production campaign; coupling pin work at every stand change	CRUSH PINCH	PSC Position & Reach Interfaces · PSC Striking & Alignment Interfaces
Overhead crane (mill floor)	Stand, roll, and spindle crane operations in the confined bar mill aisle; workers guide assemblies between closely spaced stands	LINE-OF-FIRE	PSC Load Control Interfaces
Finishing bay — bundling & transfer	Bundle transfer chain maintenance, tying machine jam clearing, and bundle guide adjustment throughout the finishing bay during production	LACERATION CAUGHT-BETWEEN	PSC Position & Reach Interfaces · PSC Striking & Alignment Interfaces

6 BAR & ROD MILL QUICK ASSESSMENT CHECKLIST

Use during a plant walkdown or shutdown planning session. Answer based on current observed practice.

- ☐ During guide box setting at any rolling stand, does the worker's hand enter the guide throat area before the roll drive is confirmed positively isolated?
- ☐ During coupling pin driving at bar mill stands, is the holding hand in the strike zone when the hammer blow is applied?
- ☐ During pinch roll surface inspection, does the inspection hand approach the nip line before roll rotation is confirmed mechanically prevented?
- ☐ During flying shear blade change, is the shear drum mechanically locked against rotation — not just de-energised at the panel?
- ☐ In the cooling bed chain mechanism, is the chain held stationary by a mechanical means during link pin removal — or only by the brake?
- ☐ When tying machine jams are cleared, is the tying head positively isolated before the operator's hand enters the mechanism?
- ☐ Is there a documented hand position requirement for guide setting at each stand — or is the safe method left to individual operator practice?
- ☐ During cold shear blade replacement, does blade guidance into the holder involve direct hand contact with the blade edge or body?
- ☐ During stand crane lifts in the mill aisle, are anti-tangle taglines used throughout the full landing sequence?

If you answered **Yes** to any of the above, PSC can review those tasks and recommend representative hands-free engineered interfaces to consider. Contact Shivani at **+91-96031-66448** or **sales@pschandsafety.com**

7 PSC ENGINEERING INTERFACE PORTFOLIO — BAR & ROD MILL

The following PSC engineering interfaces are relevant to the hand exposure scenarios identified in this chapter. This table introduces PSC product families and their primary engineering functions. It does not map any product to a specific scenario or application.

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PSC ENGINEERING INTERFACE	PRIMARY FUNCTION	REPRESENTATIVE PART NUMBERS
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PSC SafeGuider Tool	Provides controlled standoff access to confined, hot or hazardous locations during maintenance	PSC-STGT-36 PSC-STGT-48
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PSC ENGINEERING INTERFACE	PRIMARY FUNCTION	REPRESENTATIVE PART NUMBERS
PSC FingerSaver®	Holds slogging spanners, drifts, chisels and punches during hammer striking, keeping the holding hand outside the impact zone	PSC-FS-295 PSC-FS-375 PSC-FS-850
PSC Chisel & Punch Holder	Holds narrow chisels and punches during light hammer striking where a smaller holding interface is required	PSC-CPH
Selection of the appropriate engineering interface depends on the specific application, load characteristics, work method and site conditions. Contact PSC Hand Safety India for application-specific engineering guidance and product recommendations.		

— APPLICATION-SPECIFIC ENGINEERING GUIDANCE

If any hand exposure scenario in this chapter reflects tasks in your plant or maintenance team, PSC Hand Safety India can provide application-specific engineering guidance. Bring the task, the component, the work method, and the site conditions — PSC will identify the most appropriate engineering interface for your specific application.

TO RECEIVE APPLICATION-SPECIFIC GUIDANCE, DESCRIBE:

1. The specific task or operation
2. The equipment type and component
3. The component weight and geometry
4. Whether the component is ferrous
5. The work method currently in use
6. The frequency of the task
7. The working environment and access constraints
8. Your plant name and location

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Wire Rod Mill

This chapter identifies typical manual hand exposure scenarios encountered in this department of an integrated steel plant and highlights representative PSC application solutions commonly used for similar industrial tasks. Final product selection should always consider the specific task, component geometry, operating environment and site risk assessment.

1 DEPARTMENT OVERVIEW

Facilitator opening: Ask the audience what the speed of the wire rod at the finishing block exit is — and then ask what happens to the coil on the Stelmor conveyor for the next fifteen to twenty minutes. Most wire rod crews know the exit speed — it is one of the defining technical parameters of their mill. Very few have been asked to describe what maintenance happens on or near the Stelmor conveyor while rod is cooling on it. That gap — between awareness of the process and awareness of the hand exposure — is the starting point for this chapter.

The Wire Rod Mill rolls reheated billets into wire rod coils — typically 5.5–20 mm diameter — at very high rolling speeds. The billet passes through a series of roughing, intermediate, and pre-finishing stands, then through the high-speed finishing block — a compact multi-stand unit — and finally through a water box cooling section before being laid onto a Stelmor conveyor by the laying head. On the Stelmor conveyor, the rod coil cools under controlled conditions before being collected, compacted, and tied for despatch.

From a hand safety perspective, the wire rod mill has two distinct exposure profiles. In the rolling section — roughing, intermediate, finishing block, and water boxes — the scenarios parallel the bar mill at the rolling stands but with higher speeds, more compact equipment, and guide and water box changes as the primary hand exposure tasks. In the finishing section — laying head, Stelmor conveyor, coil collector, and compactor — the hot, fast-moving coil, the conveyor fan maintenance, and the compactor and tying mechanism create a different set of hazards not found in the upstream rolling section.

2 MAJOR EQUIPMENT

ROUGHING, INTERMEDIATE & PRE-FINISHING STANDS

Compact two-high or cantilever stands reduce the billet through a series of passes. Guide boxes, twist pipes, and roller guides are changed frequently. Roll change and guide setting follow the same pattern as the bar mill but in a more confined environment at higher speeds.

HIGH-SPEED FINISHING BLOCK

A compact multi-stand unit — typically 8 to 10 stands in a single housing — runs at very high speed to achieve final rod diameter. Rolls in the finishing block are tungsten carbide rings rather than steel rolls. Ring change, guide work, and block maintenance require access to a very compact machine with extremely tight tolerances and small components.

WATER BOX (COOLING SECTION)

A series of water-cooled tubes through which the rod passes after the finishing block. Water boxes control the rod temperature entering the laying head. Nozzle inserts, water seals, and water box tube liners are replaced periodically. Workers access water box interiors through end flanges — in a wet, confined environment near the high-speed rod exit.

LAYING HEAD

A rotating tube assembly that forms the rod into coils and lays them onto the Stelmor conveyor. The laying head tip — the final rotating contact point with the rod — wears and must be replaced. Laying pipe and laying head bearing maintenance are critical tasks requiring precise work on a rotating assembly.

STELMOR CONVEYOR & FANS

A long roller conveyor — typically 80–120 m — carries the rod coil while large fans below the conveyor control the cooling rate. Fan blades, fan housings, and conveyor roller drives require maintenance. Workers access fan assemblies and conveyor rollers while the conveyor is transporting hot rod.

COIL COLLECTOR, COMPACTOR & TYING MACHINE

At the conveyor exit, coils are collected onto a vertical mandrel, then compacted and tied. The compactor mechanism and tying wire system present the same laceration and caught-between hazards as the bar mill bundler — but with the additional complexity of the rotating coil collector mandrel.

3 MANUAL TASKS & HAND EXPOSURE SCENARIOS

ZONE A — FINISHING BLOCK · WATER BOX · GUIDE SYSTEMS

• HIGH · EXPOSURE FREQUENCY

Finishing Block — Tungsten Carbide Ring Change & Guide Work

PINCH / LACERATION

WHY THE HAND IS THERE

Tungsten carbide rings in the finishing block wear and must be replaced. Ring change requires the hand to access the compact block housing, remove the old ring assembly, and position the new ring with precise alignment. The rings are extremely hard and have sharp edges when chipped or fractured. Guide inserts inside the block must also be replaced by hand in a very confined space with multiple pass entries in close proximity.

HAND INTERFACE

Tungsten carbide ring edge and face, ring retaining nut, guide insert body and mounting thread, block housing bore, block entry throat

EXPOSURE TYPE

Laceration from chipped carbide ring edge; pinch between ring and housing bore during insertion; hand struck if spanner slips on retaining nut in confined block housing

"During ring change in the finishing block, how is the old ring extracted from the bore — and what does the worker's hand contact during the extraction and reinsertion sequence?"

ENGINEERING INTERFACE CONSIDERATION

Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.

• HIGH · EXPOSURE FREQUENCY

Water Box — Nozzle Insert & Tube Liner Replacement

LINE-OF-FIRE / PINCH

WHY THE HAND IS THERE

Water box nozzle inserts direct water flow around the rod for controlled quenching. Inserts wear or block and must be replaced. Tube liner sections inside the water box also wear from rod contact and require replacement. Workers access the water box interior through end flanges — in a wet environment with residual water pressure if isolation is incomplete.

HAND INTERFACE

Nozzle insert body and thread, tube liner section, end flange face, water box bore interior, isolation valve handle

EXPOSURE TYPE

Hand in line of fire of residual pressurised water if isolation is incomplete; pinch between liner section and bore during insertion; laceration from liner edge during removal

"When a water box nozzle insert is replaced, what confirms that water pressure in that specific box is fully relieved — and is that check made at the box itself or at the control panel?"

ENGINEERING INTERFACE CONSIDERATION

Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.

• HIGH · EXPOSURE FREQUENCY

Laying Head — Tip Change & Laying Pipe Maintenance

CRUSH / BURNS / CAUGHT-BETWEEN

WHY THE HAND IS THERE

The laying head tip — the final contact point with the rod — wears rapidly and must be changed frequently. The tip is a precision refractory or cast component threaded or clamped into the end of the rotating laying pipe. Workers access the tip while the laying head is stationary but still warm, in a confined area between the exit water box and the Stelmor conveyor entry.

HAND INTERFACE

Laying tip body and thread, laying pipe end, tip retaining clamp, laying head rotation bearing area, conveyor entry guard

EXPOSURE TYPE

Burns from hot laying tip and pipe; hand crushed between laying pipe and guard structure if laying head rotates unexpectedly; pinch at tip retaining clamp during removal

"During laying head tip change, what confirms that the laying head rotation drive is positively isolated — not just stopped — before the operator's hand approaches the tip and pipe assembly?"

ENGINEERING INTERFACE CONSIDERATION

Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.

ZONE B — STELMOR CONVEYOR · COIL COLLECTOR · COMPACTOR & TYING

• HIGH · EXPOSURE FREQUENCY

Stelmor Conveyor — Roller Drive & Fan Blade Maintenance

CAUGHT-BETWEEN / STRUCK-BY

WHY THE HAND IS THERE

Stelmor conveyor rollers, drive couplings, and the large fans below the conveyor floor require maintenance. Fan blade tips are close to the fan housing; blade replacement requires the hand to enter the fan housing. Conveyor roller coupling maintenance follows the same pattern as the run-out table but in a longer, more confined structure with hot rod coils on adjacent sections of the conveyor.

HAND INTERFACE

Fan blade tip and retaining bolt, fan housing interior, conveyor roller coupling pin, coupling guard fixing bolt

EXPOSURE TYPE

Hand struck by fan blade if fan rotates unexpectedly during blade maintenance; caught-between at roller coupling if adjacent roller section restarts; hand struck by coupling pin under spring tension

"During Stelmor fan blade replacement, is the fan drive positively locked against rotation — not just de-energised — before the operator's hand enters the fan housing to reach the blade tips?"

ENGINEERING INTERFACE CONSIDERATION

Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.

• MEDIUM · EXPOSURE FREQUENCY

Coil Collector — Mandrel & Coil Guide Maintenance

CRUSH / BURNS

WHY THE HAND IS THERE

The coil collector mandrel receives hot coils from the Stelmor conveyor and collects them into a vertical stack. Mandrel segments, guide fingers, and the mandrel lifting mechanism require maintenance. Workers access mandrel components in the coil collection area where hot coils are deposited at regular intervals — and the mandrel may retain heat from recent coil collection.

HAND INTERFACE

Mandrel segment face and locking pin, guide finger body and pivot, mandrel lifting arm, coil guide rail

EXPOSURE TYPE

Burns from hot mandrel surface; hand crushed between mandrel segment and collection frame during segment maintenance; hand struck by guide finger if coil collection sequence starts unexpectedly

"During mandrel segment maintenance, is the coil collection sequence — including the mandrel rotation and lift cycle — confirmed positively isolated before any hand contacts the mandrel body or guide fingers?"

ENGINEERING INTERFACE CONSIDERATION

Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.

• MEDIUM · EXPOSURE FREQUENCY

Coil Compactor & Tying Machine — Jam Clearing & Maintenance

LACERATION / CAUGHT-BETWEEN

WHY THE HAND IS THERE

The coil compactor presses the loose coil into a compact bundle for tying. Tying wire and binding band are applied under tension by the tying machine. Jams in the compactor mechanism, tying head failures, and binding band tangles require manual clearing — with the same laceration and caught-between hazards as the bar mill tying machine, but with heavier coil mass and greater spring-back force in the tying wire.

HAND INTERFACE

Tying wire and binding band under tension, compactor arm and press, tying head mechanism, coil body during jam clearing

EXPOSURE TYPE

Laceration from tying wire and binding band under tension; hand caught in compactor arm if mechanism restarts; struck-by from binding band spring-back if tension releases suddenly

"When a tying wire jam is cleared at the coil tying machine, is the compactor positively de-energised and the tying head mechanically prevented from cycling before the operator's hand enters the tying zone?"

ENGINEERING INTERFACE CONSIDERATION

Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.

4 SHUTDOWN & OVERHAUL — ADDITIONAL EXPOSURE

LOW exposure frequency refers to how often the hand is exposed in normal operations, not to the consequence if contact occurs.

TASK	HAND EXPOSURE	FREQ.	EXPOSURE	PSC ENGINEERING INTERFACE PORTFOLIO
Finishing block full overhaul	All rings, guides, and cassettes removed and refurbished; workers handle precision components in the compact block housing; chipped carbide ring handling throughout	LOW	LACERATION / PINCH	PSC Position & Reach Interfaces · PSC Striking & Alignment Interfaces
Stelmor conveyor full roller replacement	All conveyor rollers replaced sequentially; coupling pin and guard work along the full conveyor length	LOW	CAUGHT-BETWEEN	PSC Position & Reach Interfaces · PSC Striking & Alignment Interfaces
Laying head bearing & pipe replacement	Laying head assembly removed for bearing change; heavy rotating assembly guided during crane lift and reinstallation	LOW	CRUSH / BURNS	PSC Load Control Interfaces · PSC Position & Reach Interfaces
Roll stand overhaul (roughing/intermediate)	Housing lifts, roll extraction, and spindle work across all roughing and intermediate stands; same pattern as bar mill but more compact environment	LOW	CRUSH / PINCH	PSC Load Control Interfaces · PSC Striking & Alignment Interfaces

5 CONTRACTOR & MOBILE EQUIPMENT INTERFACES

ACTIVITY / EQUIPMENT	HAND EXPOSURE SCENARIO	EXPOSURE	PSC ENGINEERING INTERFACE PORTFOLIO
Roll & ring change crew	High-frequency guide, roll, and ring changes at all stands; finishing block ring work requiring precision handling of sharp carbide components	LACERATION PINCH	PSC Position & Reach Interfaces · PSC Striking & Alignment Interfaces
Stelmor fan maintenance contractor	Fan blade inspection and replacement at multiple fan positions along the conveyor; hand access into fan housings in an environment where adjacent fans may be live	STRUCK-BY	PSC Position & Reach Interfaces · PSC Striking & Alignment Interfaces
Overhead crane (mill & finishing)	Laying head assembly, finishing block cassette, and roll stand housing crane operations in the confined wire rod mill bay	CRUSH	PSC Load Control Interfaces

6 WIRE ROD MILL QUICK ASSESSMENT CHECKLIST

Use during a plant walkdown or shutdown planning session. Answer based on current observed practice.

- ☐ During finishing block ring change, does the worker's hand contact the carbide ring body or the block housing bore during extraction and reinsertion?
- ☐ When water box nozzle inserts are replaced, is water pressure in the specific box confirmed relieved at the box itself — not only at the control panel?
- ☐ During laying head tip change, is the laying head rotation drive positively locked against rotation before any hand approaches the tip and pipe assembly?
- ☐ During Stelmor fan blade replacement, is the fan drive mechanically locked — not just de-energised — before the operator's hand enters the fan housing?
- ☐ During Stelmor conveyor roller coupling maintenance, is the specific roller section isolated from adjacent sections that may still be running?
- ☐ During coil collector mandrel maintenance, is the full coil collection sequence — rotation, lift, and guide finger cycle — positively isolated before hands contact the mandrel?
- ☐ When tying machine or compactor jams are cleared, is the tying head mechanically prevented from cycling before the operator's hand enters the tying zone?
- ☐ At the roughing and intermediate stands, is the roll drive positively isolated before guide box setting work places the worker's hand near the roll pass?

If you answered **Yes** to any of the above, PSC can review those tasks and recommend representative hands-free engineered interfaces to consider. Contact Shivani at **+91-96031-66448** or **sales@pschandsafety.com**

7 PSC ENGINEERING INTERFACE PORTFOLIO — WIRE ROD MILL

The following PSC engineering interfaces are relevant to the hand exposure scenarios identified in this chapter. This table introduces PSC product families and their primary engineering functions. It does not map any product to a specific scenario or application.

PSC LOAD CONTROL INTERFACES		
PSC ENGINEERING INTERFACE	PRIMARY FUNCTION	REPRESENTATIVE PART NUMBERS
PSC LoadGuider® Anti-Tangle Tagline	Controls suspended loads from a safe distance during crane operations	PSC-LGTC-15 PSC-LGTC-20 PSC-LGTC-25 PSC-LGTC-30
PSC Guidelt® Safety Rigger Tagline	Provides a safe, reusable tagline interface for controlling suspended loads from a stand-off distance throughout the lifting operation	PSC-GISRT-10 PSC-GISRT-15
PSC RiggerMate® Hook	Positions slings, shackles and rigging components without direct hand contact on rigging	PSC-RMH
PSC TaglineRetriever	Retrieves tagline rope ends after load landing without the operator entering the load zone	PSC-TRT PSC-TRT-3P
PSC POSITION & REACH INTERFACES		
PSC ENGINEERING INTERFACE	PRIMARY FUNCTION	REPRESENTATIVE PART NUMBERS
PSC LoadGuider® Push/Pull Pole	Pushes and pulls loads, components and rigging at a safe standoff distance	PSC-LG-42 PSC-LG-50 PSC-LG-72 PSC-LG-96
PSC Guide-It® Push/Pull Pole	Heavy-duty extended-reach push/pull for higher-force load guidance and positioning	PSC-GIT-50 PSC-GIT-72 PSC-GIT-96
PSC Load-It® Push/Pull Tool	Positions, guides and controls components using interchangeable heads suited to specific load geometries	PSC-LIT-S004 PSC-LIT-S006 PSC-LIT-S008
PSC SafeGuider Tool	Provides controlled standoff access to confined, hot or hazardous locations during maintenance	PSC-STGT-36 PSC-STGT-48
PSC STRIKING & ALIGNMENT INTERFACES		
PSC ENGINEERING INTERFACE	PRIMARY FUNCTION	REPRESENTATIVE PART NUMBERS
PSC FingerSaver®	Holds slogging spanners, drifts, chisels and punches during hammer striking, keeping the holding hand outside the impact zone	PSC-FS-295 PSC-FS-375 PSC-FS-850
PSC Chisel & Punch Holder	Holds narrow chisels and punches during light hammer striking where a smaller holding interface is required	PSC-CPH
Selection of the appropriate engineering interface depends on the specific application, load characteristics, work method and site conditions. Contact PSC Hand Safety India for application-specific engineering guidance and product recommendations.		

— APPLICATION-SPECIFIC ENGINEERING GUIDANCE

If any hand exposure scenario in this chapter reflects tasks in your plant or maintenance team, PSC Hand Safety India can provide application-specific engineering guidance. Bring the task, the component, the work method, and the site conditions — PSC will identify the most appropriate engineering interface for your specific application.

TO RECEIVE APPLICATION-SPECIFIC GUIDANCE, DESCRIBE:

1. The specific task or operation
2. The equipment type and component
3. The component weight and geometry
4. Whether the component is ferrous
5. The work method currently in use
6. The frequency of the task
7. The working environment and access constraints
8. Your plant name and location

ENGINEERING GUIDANCE

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Hand Exposure in Integrated Steel Plants — A Department-by-Department Engineering Reference

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Chapter 13 of 22 · Version 2

ENGINEER THE HAND OUT OF THE HAZARD™

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Roll Shop

This chapter identifies typical manual hand exposure scenarios encountered in this department of an integrated steel plant and highlights representative PSC application solutions commonly used for similar industrial tasks. Final product selection should always consider the specific task, component geometry, operating environment and site risk assessment.

1 DEPARTMENT OVERVIEW

Facilitator opening: Ask the audience what the most common source of premature bearing failure in their rolling mills is. In most plants the answer — when investigated — is the roll shop: contaminated bearing housings during reassembly, incorrect bearing clearance settings, inadequate lubrication application, or chock bolt torque errors that allow fretting under load. The roll shop is not where things get fixed. It is where the next failure either starts or is prevented. The hand exposure scenarios in this chapter all occur at that decision point — in the workshop, at the bench, at the grinder, at the press — not on the mill floor.

The Roll Shop is the central precision engineering support function serving all rolling mills in the integrated plant — typically Hot Strip Mill, Plate Mill, Bar and Rod Mill, Wire Rod Mill, and Cold Rolling Mill. It is not a production department. It is the facility through which every rolling component passes between campaigns: rolls, chocks, bearings, seals, TC ring assemblies, and cassettes are received from the mill, inspected, dismantled, measured, reconditioned, reassembled, and returned to production. The quality of the work done here determines roll performance, strip or section quality, bearing life, and the hand exposure risk at the mill stand on the next campaign.

This chapter does not cover roll changes at the mill stand housing window, coupling spindle work, or chock locking system engagement — those scenarios are covered in the respective mill chapters. This chapter covers the manual hand exposure scenarios that occur inside the Roll Shop itself, from the moment a component arrives from the mill to the moment it leaves for the next campaign. The chapter is organised by function — following the lifecycle of a rolling component through the workshop — rather than by mill type.

2 WORKSHOP FUNCTIONS & EQUIPMENT

ROLL RECEIPT & TRANSPORT

Rolls and chock assemblies arrive from the mill on transport cars or slings. The overhead Roll Shop crane unloads them onto storage saddles in the receipt bay. Assemblies arrive warm, scale-contaminated, and greasy from rolling coolant. Crane guidance and saddle landing are the primary hand exposure tasks at this stage.

CLEANING BAY

Scale, coolant residue, and oxide are removed from rolls and chocks before inspection. High-pressure washing, abrasive cleaning, and solvent cleaning are used depending on component type. Chock bearing seats and seal areas require careful manual cleaning before dimensional assessment.

INSPECTION & MEASUREMENT BENCH

Roll surface condition is visually assessed and roll diameter and profile measured with precision instruments. Chock bores, liner fits, and bearing seat dimensions are checked. NDT inspection of roll bodies (ultrasonic, dye penetrant) identifies sub-surface cracks that determine whether the roll is reground or scrapped.

ROLL GRINDER

CNC or conventional roll grinders re-cut the roll surface and pass profile to restore geometry and surface condition. The roll is loaded onto the grinder between centres. The drive dog is attached to the roll neck and secured. Finished ground rolls are unloaded and transferred to the assembly bay.

CHOCK PRESS & BEARING BAY

A hydraulic press removes the bearing inner race from the roll neck (de-chocking) and presses it back on during reassembly (re-chocking). Between these operations, the chock housing is cleaned, dimensionally checked, relined if necessary, and new seals and bearing races are fitted. This is the most precision-intensive and hand-intensive zone in the Roll Shop.

TC RING & CASSETTE PREPARATION AREA

Where applicable, tungsten carbide roll rings and finishing block cassettes are inspected, handled, assembled onto arbors, locked, and prepared for dispatch to the Wire Rod Mill or Bar Mill finishing sections. In-house carbide grinding is not universal — this area covers inspection, assembly, locking, and controlled handling of precision carbide components, where compatible with plant practice.

3 MANUAL TASKS & HAND EXPOSURE SCENARIOS

ZONE A — ROLL RECEIPT, TRANSPORT & CLEANING

• HIGH · EXPOSURE FREQUENCY

Roll & Chock Assembly — Crane Receipt onto Storage Saddles

CRUSH / BURNS / STRUCK-BY

WHY THE HAND IS THERE

Roll and chock assemblies arrive from the mill warm, greasy, and scale-contaminated on transport cars or in crane slings. The Roll Shop crane lands them onto storage saddles in the receipt bay. Workers guide the assembly during crane approach — the same hand exposure as at the mill housing window, but at a lower-energy, saddle-landing event rather than a housing-window insertion.

HAND INTERFACE

Roll barrel and chock body during crane guidance, crane hook and sling at chock lifting lug, storage saddle top face during landing

EXPOSURE TYPE

Hand crushed between chock body and saddle during landing; burns from elevated temperature on roll or chock surface; struck-by if crane hook or sling shifts during approach to saddle

"When a returned roll and chock assembly is landed onto the Roll Shop receipt saddle, what controls the final approach — and where are the guiding hands relative to the saddle contact zone at the moment of landing?"

ENGINEERING INTERFACE CONSIDERATION

Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.

ZONE B — INSPECTION, MEASUREMENT & GRINDER LOADING

• HIGH · EXPOSURE FREQUENCY

Roll Grinder — Loading onto Centres & Drive Dog Work

CRUSH / IMPACT / PINCH

WHY THE HAND IS THERE

The roll is loaded between the grinder headstock and tailstock centres by overhead crane. Workers guide the roll neck into the centre cup during crane lowering — with the roll body between the centres and the headstock drive dog still to be fitted. The drive dog is attached to the roll neck and secured by a clamping bolt or pin that is tightened by hand and then hammer-driven for positive engagement.

HAND INTERFACE

Roll neck surface during centre engagement, drive dog body and clamping face, drive dog securing bolt or pin, grinder headstock face, tailstock centre cup

EXPOSURE TYPE

Hand crushed between roll neck and headstock during centre engagement; impact from hammer on drive dog securing pin with holding hand in strike zone; pinch at drive dog clamping face during tightening

"When the drive dog is fitted to the roll neck before grinding, what holds the drive dog in position while the securing pin or bolt is driven — and where is the holding hand relative to the hammer strike path?"

ENGINEERING INTERFACE CONSIDERATION

Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.

• MEDIUM · EXPOSURE FREQUENCY

Inspection Bench — Ferrous Component Positioning & Handling

CRUSH / PINCH

WHY THE HAND IS THERE

Rolls, chock components, bearing races, and seal housings are repositioned on the inspection bench for dimensional measurement, surface assessment, and NDT work. Ferrous components of varying weights are turned, presented to gauges, and moved between measurement positions — often without mechanical aids, relying on direct hand contact to control position and prevent rolling or shifting on the bench surface.

HAND INTERFACE

Roll barrel and neck, chock body and bore face, bearing outer race face, seal housing, bench surface

EXPOSURE TYPE

Hand crushed between component and bench if component rolls or shifts unexpectedly; pinch between chock body and adjacent component; hand struck if component falls from bench during repositioning

"When a roll or chock component is repositioned on the inspection bench for measurement, what prevents it from rolling or shifting — and is that control provided by the bench itself, by a tool, or by the worker's hand?"

ENGINEERING INTERFACE CONSIDERATION

Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.

ZONE C — CHOCK DISASSEMBLY, BEARING WORK & SEAL FITTING

• HIGH · EXPOSURE FREQUENCY

Bearing Race Driving — Removal & Fitting on Roll Neck

IMPACT / CRUSH / PINCH

WHY THE HAND IS THERE

Bearing inner races are pressed or driven onto and off the roll neck. Where a hydraulic press is used, the operator positions the drift or adapter against the bearing race by hand before the press cycle begins. Where a hammer-and-drift method is used — common in many plants for certain race sizes — the holding hand steadies the drift against the bearing face during hammer blows. This is the highest-frequency FingerSaver® application in the Roll Shop.

HAND INTERFACE

Bearing drift body and face, roll neck surface, bearing inner race face, hydraulic press adapter, press table

EXPOSURE TYPE

Hand struck by hammer when holding drift; crush between drift and roll neck if drift slips; pinch between bearing race and press adapter during positioning; hand in line of fire if hydraulic press strokes unexpectedly

"During bearing race driving on the roll neck, is the drift held by hand during hammer blows — and if so, what tool or method is used to hold the drift while keeping the operator's hand out of the strike zone?"

ENGINEERING INTERFACE CONSIDERATION

Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.

• HIGH · EXPOSURE FREQUENCY

Snap Ring & Retaining Ring — Removal & Refitting in Chock Bore

PINCH / STRUCK-BY

WHY THE HAND IS THERE

Snap rings and retaining rings secure bearing assemblies within the chock bore and on the roll neck. Removal requires snap ring pliers or a drift and hammer — with the ring under significant spring tension in the groove. During removal the ring can release suddenly. Refitting requires compressing or expanding the ring to the groove diameter while aligning it precisely in the bore — with both hands in the bore space for some chock sizes.

HAND INTERFACE

Snap ring body and tangs, ring plier tips in tang holes, chock bore face and groove, drift end on ring body, roll neck groove

EXPOSURE TYPE

Struck-by if snap ring releases under tension during removal; pinch between ring and groove if ring slips during refitting; hand struck by drift if snap ring is driven rather than plier-removed

"When a snap ring is removed from the chock bore, what controls the ring if it releases suddenly under tension — and is the operator's face and hands clear of the release trajectory?"

ENGINEERING INTERFACE CONSIDERATION

Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.

• HIGH · EXPOSURE FREQUENCY

Chock Press — De-chocking & Re-chocking (Bearing off/on Roll Neck)

LINE-OF-FIRE / CRUSH

WHY THE HAND IS THERE

The hydraulic chock press removes (de-chocking) and reinstalls (re-chocking) the bearing assembly onto the roll neck. Workers position the roll and chock on the press table, align the press adapter against the bearing, and initiate the press cycle. Correct alignment requires manual adjustment of the roll and chock on the press table — with the press ram in close proximity. Cold rolling mill work roll sleeves present an additional handling and alignment task at this stage where applicable.

HAND INTERFACE

Roll barrel during table positioning, press adapter face during alignment, chock body during table seating, press table edge

EXPOSURE TYPE

Hand in line of fire if press strokes during alignment adjustment; crush between roll and press table if roll shifts; pinch at press adapter during alignment with ram extended

"During chock press alignment before the press cycle begins, is the press ram confirmed retracted and the press in a hold state before any hand is placed on the roll or adapter to make final positioning adjustments?"

ENGINEERING INTERFACE CONSIDERATION

Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.

ZONE D — TC RING & CASSETTE PREPARATION (WHERE APPLICABLE)**• MEDIUM • EXPOSURE FREQUENCY****TC Ring Assembly — Handling, Inspection & Cassette Loading****LACERATION / PINCH****WHY THE HAND IS THERE**

Tungsten carbide roll rings are inspected, mounted onto arbors, and locked into cassettes before dispatch to the Wire Rod Mill or Bar Mill finishing sections. Rings are precision components — small in diameter relative to their weight, and extremely hard with sharp edges when chipped or fractured. Cassette locking pins and retaining screws are driven by hand. Not all plants carry out carbide grinding in-house; this scenario covers inspection, assembly, and cassette loading where it reflects plant practice.

HAND INTERFACE

TC ring body and edge, ring arbor face, cassette housing, locking pin body, retaining screw head, cassette mounting face

EXPOSURE TYPE

Laceration from chipped carbide ring edge during handling or inspection; pinch between ring and arbor during mounting; hand struck at locking pin during pin driving if holding hand is in strike zone

"During TC ring inspection and cassette loading, what controls the ring's position on the arbor before the locking pin is engaged — and is that control provided by a tool or by the worker's hand?"

ENGINEERING INTERFACE CONSIDERATION

Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.

ZONE E — ROLL ASSEMBLY, FINAL INSPECTION & DISPATCH**• HIGH • EXPOSURE FREQUENCY****Dressed Roll Assembly — Crane Dispatch to Transport Car****CRUSH / STRUCK-BY****WHY THE HAND IS THERE**

The completed roll and chock assembly — freshly ground roll, new bearings, new seals, torqued chock bolts — is lifted by the Roll Shop crane and placed onto the transport car or exchange table for dispatch to the mill. This is the mirror of the receipt operation but with a more precise landing requirement: the roll must be placed precisely onto the transport car saddle at the correct orientation for the mill change sequence.

HAND INTERFACE

Roll chock body during crane guidance, crane hook at chock lifting lug, transport car saddle top during landing, sling end at chock

EXPOSURE TYPE

Hand crushed between chock body and transport car saddle during landing; struck-by if crane hook or sling shifts during precise landing approach

"During the final crane landing of the dressed roll assembly onto the transport car, what controls the assembly's orientation — and where are the guiding hands at the moment the chock contacts the saddle?"

ENGINEERING INTERFACE CONSIDERATION

Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.

4 SHUTDOWN & HIGH-VOLUME CAMPAIGNS — ADDITIONAL EXPOSURE

LOW exposure frequency refers to how often the hand is exposed in normal operations, not to the consequence if contact occurs. During mill annual shutdowns, Roll Shop throughput — and cumulative hand exposure across the crew — is substantially higher than during normal campaign operations.

TASK	HAND EXPOSURE	FREQ.	EXPOSURE	PSC ENGINEERING INTERFACE PORTFOLIO
Backup roll chock full overhaul	Large backup roll chocks fully dismantled; oil film bearing or large roller bearing removal, inspection, and reassembly; heavy components with very tight fits requiring press and drift work throughout	LOW	CRUSH / IMPACT	PSC Striking & Alignment Interfaces
Chock liner replacement	Worn chock liners on the housing window contact faces machined out and new liners fitted; hammer and drift or press work to seat new liners in chock body	MED	IMPACT / PINCH	PSC Striking & Alignment Interfaces
Roll balancing — heavy finishing rolls	Large rolls mounted on balance machine arbor by crane; workers guide roll onto balance machine centres with the same crane guidance exposure as the grinder loading task	LOW	CRUSH	PSC Load Control Interfaces · PSC Position & Reach Interfaces
High-volume seal change campaign	All seals replaced across the chock inventory during an annual overhaul; repetitive seal fitting and retaining ring work across many chocks in sequence — cumulative struck-by exposure across the crew	LOW	PINCH / IMPACT	PSC Striking & Alignment Interfaces

5 CONTRACTOR & SERVICE PROVIDER INTERFACES

ACTIVITY	HAND EXPOSURE SCENARIO	EXPOSURE	PSC ENGINEERING INTERFACE PORTFOLIO
Roll Shop crane operator & rigger	All roll assembly crane lifts throughout the Roll Shop — receipt, grinder loading, press table positioning, dispatch; rigging attachment and sling end positioning at chock lifting lugs	CRUSH STRUCK-BY	PSC Load Control Interfaces
OEM chock repair contractor	Major chock repairs contracted to specialist firms; same bearing race driving, snap ring, and press work scenarios as in-house, but often performed under tighter campaign time pressure	IMPACT / CRUSH	PSC Striking & Alignment Interfaces
TC cassette / block preparation contractor	Where TC cassette preparation is contracted or carried out by a specialist team within the plant, the same ring handling, locking pin, and cassette loading hand exposure applies	LACERATION / PINCH	PSC Position & Reach Interfaces · PSC Striking & Alignment Interfaces

6 ROLL SHOP QUICK ASSESSMENT CHECKLIST

Use during a Roll Shop walkdown or overhaul planning session. Answer based on current observed practice.

- ☐ When roll and chock assemblies are landed onto receipt saddles by crane, is the guiding hand clear of the saddle contact zone before the assembly touches down?
- ☐ During grinder drive dog fitting, is the securing pin or bolt held by a tool — rather than by the operator's hand — during hammer driving?
- ☐ On the inspection bench, are ferrous components held in position by a bench stop, a magnetic tool, or a fixture — rather than by the worker's hand — during repositioning and measurement?
- ☐ During bearing race driving with hammer and drift, is the drift held by a FingerSaver® or equivalent tool — rather than by the bare hand — during each hammer blow?
- ☐ During snap ring removal from the chock bore, are the operator's hands and face clear of the ring's release trajectory if it springs free under tension?
- ☐ During chock press alignment, is the press ram confirmed retracted and in a hold state before any hand contacts the roll or adapter for final positioning?
- ☐ During TC ring mounting onto the arbor, is the ring's position controlled by a tool rather than by the worker's hand before the locking pin is engaged?
- ☐ During cassette locking pin driving, is the pin held by a FingerSaver® or equivalent tool during the hammer blow?
- ☐ During the final crane landing of a dressed roll assembly onto the transport car saddle, is the guiding hand clear of the chock-to-saddle contact zone before touchdown?
- ☐ During high-volume seal or bearing campaigns, is the cumulative struck-by exposure from repeated drift and pin driving across the crew tracked as a group exposure — not assessed only at the individual task level?

If you answered **Yes** to any of the above, PSC can review those tasks and recommend representative hands-free engineered interfaces to consider. Contact Shivani at **+91-96031-66448** or **sales@pschandsafety.com**

7 PSC ENGINEERING INTERFACE PORTFOLIO — ROLL SHOP

The following PSC engineering interfaces are relevant to the hand exposure scenarios identified in this chapter. This table introduces PSC product families and their primary engineering functions. It does not map any product to a specific scenario or application.

PSC LOAD CONTROL INTERFACES		
PSC ENGINEERING INTERFACE	PRIMARY FUNCTION	REPRESENTATIVE PART NUMBERS
PSC LoadGuider® Anti-Tangle Tagline	Controls suspended loads from a safe distance during crane operations	PSC-LGTC-15 PSC-LGTC-20 PSC-LGTC-25 PSC-LGTC-30
PSC Guidelt® Safety Rigger Tagline	Provides a safe, reusable tagline interface for controlling suspended loads from a stand-off distance throughout the lifting operation	PSC-GISRT-10 PSC-GISRT-15
PSC RiggerMate® Hook	Positions slings, shackles and rigging components without direct hand contact on rigging	PSC-RMH
PSC TaglineRetriever	Retrieves tagline rope ends after load landing without the operator entering the load zone	PSC-TRT PSC-TRT-3P
PSC MANUAL LIFTING INTERFACES		
PSC ENGINEERING INTERFACE	PRIMARY FUNCTION	REPRESENTATIVE PART NUMBERS
PSC Lift Assist Sling — Single Handle	Provides an engineered carry interface for components without a designed grip point, within manual handling limits	HSF-SH-075
PSC Lift Assist Sling — Double Handle	Provides a two-person engineered carry interface for longer components, within manual handling limits	HSF-DH-100
PSC Lift Assist Sling — Valve & Motor	Provides an engineered carry interface for valves, small motors and small pump bodies	HSF-CV
PSC Handle-Tech Pipe Lifter	Provides an engineered grip interface for pipe and hose carry without barrel gripping or finger-beneath-pipe contact	PSC-HTL-002 PSC-HTL-004 PSC-HTL-006
PSC EzyLift Pipe Lifting Tool	Provides a wrist-neutral lift interface for pipe and bar sections from floor or rack surfaces	PSC-EZYLFT
PSC STRIKING & ALIGNMENT INTERFACES		
PSC ENGINEERING INTERFACE	PRIMARY FUNCTION	REPRESENTATIVE PART NUMBERS
PSC FingerSaver®	Holds slogging spanners, drifts, chisels and punches during hammer striking, keeping the holding hand outside the impact zone	PSC-FS-295 PSC-FS-375 PSC-FS-850
PSC Chisel & Punch Holder	Holds narrow chisels and punches during light hammer striking where a smaller holding interface is required	PSC-CPH
PSC MAGNETIC HANDLING INTERFACES		
PSC ENGINEERING INTERFACE	PRIMARY FUNCTION	REPRESENTATIVE PART NUMBERS
PSC Magnetic Lifter — Standard	Lifts and retrieves ferrous components from surfaces without fingers beneath the load	HSF-MG004 HSF-MG005
PSC MagHead Lifter	Retrieves ferrous components from confined or restricted locations with 360°/180° articulation	HSF-LG-001
PSC Magnetic Hand Lifter	Retrieves small ferrous components, sheet metal and freshly cut plate from surfaces	HSF-LG-MHL
PSC Multi-Grab Magnetic Handler	Handles individual ferrous components on workshop floors and decks with 360° rotation and lever release	MG004

Selection of the appropriate engineering interface depends on the specific application, load characteristics, work method and site conditions. **Contact PSC Hand Safety India for application-specific engineering guidance and product recommendations.**

— APPLICATION-SPECIFIC ENGINEERING GUIDANCE

If any hand exposure scenario in this chapter reflects tasks in your plant or maintenance team, PSC Hand Safety India can provide application-specific engineering guidance. Bring the task, the component, the work method, and the site conditions — PSC will identify the most appropriate engineering interface for your specific application.

TO RECEIVE APPLICATION-SPECIFIC GUIDANCE, DESCRIBE:

1. The specific task or operation
2. The equipment type and component
3. The component weight and geometry
4. Whether the component is ferrous
5. The work method currently in use
6. The frequency of the task
7. The working environment and access constraints
8. Your plant name and location

ENGINEERING GUIDANCE

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Cold Rolling Mill

This chapter identifies typical manual hand exposure scenarios encountered in this department of an integrated steel plant and highlights representative PSC application solutions commonly used for similar industrial tasks. Final product selection should always consider the specific task, component geometry, operating environment and site risk assessment.

1 DEPARTMENT OVERVIEW

Facilitator opening: Ask the audience what the surface quality specification for the strip leaving their cold mill is — and then ask what happens to that specification when the strip threading sequence is wrong, or when a work roll change is made with a guide misaligned, or when a coolant header nozzle is partially blocked. In most cold mills, the answer to all three is the same: a surface defect that can mean a customer rejection or a downgrade. The cold mill is not just the tightest-tolerance process in the plant — it is the one where maintenance errors have the most direct quality consequence. That is the context for the hand exposure scenarios in this chapter.

The Cold Rolling Mill reduces hot-rolled strip coils — typically from the HSM or an annealing line — to final gauge at room temperature, achieving tight thickness tolerances and controlled surface finish. Configuration varies: tandem cold mills (TCM) pass the strip continuously through four or five four-high stands at high speed; reversing cold mills (RCM) pass the strip back and forth through a single stand. Both types use high-pressure rolling oil or emulsion as coolant and lubricant. Work roll changes occur multiple times per shift. Bridle rolls, tension reels, and the entry and exit coil handling systems are maintained in a strip-threaded environment where the relationship between hand position and strip edge is the defining hazard.

This chapter covers the mill interface: roll changes, strip threading, stand access, and operating-mill maintenance. De-chocking, bearing work, and seal fitting for cold mill work rolls are covered in Chapter 14 — Roll Shop.

2 MAJOR EQUIPMENT

ROLLING STANDS (FOUR-HIGH, SIX-HIGH OR CLUSTER)

Work rolls and backup rolls are changed on campaign. The cold mill stand is more enclosed than a hot mill stand — the roll gap is narrower, the rolling oil creates a slippery environment, and the strip under tension passes through the stand at high speed. Work roll changes occur under time pressure between coils in the tandem mill sequence.

BRIDLE ROLLS & TENSION REELS

Bridle rolls control strip tension at the mill entry and exit. Tension reels wind and unwind the strip coil. Roll surfaces wear and require inspection; reel mandrel segments and wrapper systems require maintenance — with strip under tension on adjacent reels during production maintenance.

STRIP THREADING SYSTEM

Automatic or semi-automatic threading passes the strip head end through the mill from entry reel to exit reel at reduced speed. Manual assistance — guiding the strip head end through guides, over bridle rolls, and into the coiler mandrel — involves direct hand proximity to moving strip with sharp, tensioned edges.

SIDE TRIMMER & SCRAP CHOPPER

The side trimmer trims strip edges to final width. Trimmer blades and hold-down rolls require maintenance. The scrap chopper reduces the continuous trimming scrap into short lengths. Blade replacement, chopper anvil maintenance, and scrap guide work create laceration and crush hazards from trim scrap and blade edges.

COOLANT HEADER & SPRAY SYSTEM

Rolling oil or emulsion is delivered to the roll gap through header nozzles above and below the strip pass line. Nozzle blockages, header seal failures, and supply line maintenance require hand access in an environment saturated with rolling emulsion — increasing slipping and line-of-fire risk from pressurised coolant.

AGC HYDRAULIC SYSTEM

Automatic gauge control hydraulic cylinders maintain roll gap precision. Servo valve maintenance, cylinder seal replacement, and hose connection work follow the same high-pressure hydraulic pattern as the HSM — but in a more enclosed stand environment with strip tension and coolant saturation complicating access.

3 MANUAL TASKS & HAND EXPOSURE SCENARIOS

ZONE A — ROLLING STANDS · WORK ROLL CHANGE · STRIP THREADING

• HIGH · EXPOSURE FREQUENCY

Work Roll Change — Stand Access & Coupling Engagement

CRUSH / PINCH / LINE-OF-FIRE

WHY THE HAND IS THERE

Cold mill work roll changes occur multiple times per shift, under time pressure between coils. The roll change car extracts the worn roll and inserts the pre-ground replacement. Workers guide the incoming roll assembly into the stand window, engage the drive spindle coupling, and fit the work roll bending system connections — in an enclosed stand environment coated with rolling emulsion. The slippery surfaces, enclosed space, and time pressure combine to make this one of the most acute hand exposure tasks in the cold mill.

HAND INTERFACE

Roll neck or chock body during stand window guidance, drive coupling spindle face, coupling pin body, work roll bending block connection, stand window ledge

EXPOSURE TYPE

Hand crushed between chock and stand window on emulsion-slicked surface; hand in line of fire if roll change car moves unexpectedly; coupling pin impact with holding hand in strike zone

"During a cold mill work roll change, at which step does the worker's hand enter the stand window area — and is the rolling emulsion removed from the contact surfaces at that point, or is the work done on wet, slippery surfaces?"

ENGINEERING INTERFACE CONSIDERATION

Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.

• HIGH · EXPOSURE FREQUENCY

Strip Threading — Manual Guidance of Strip Head End

LACERATION / LINE-OF-FIRE

WHY THE HAND IS THERE

During strip threading after a roll change or new coil entry, the strip head end must be guided through entry guides, over bridge rolls, through the stand, and into the exit coiler mandrel. In semi-automatic or manual threading modes, workers assist the head end through guides and around bridge rolls — with the strip edge under tension and moving at threading speed. The strip edge is sharp and the strip can deflect or buckle unexpectedly if threading tension is incorrect.

HAND INTERFACE

Strip head end body and edge, entry guide lip, bridge roll surface, threading guide deflector, coiler mandrel entry slot

EXPOSURE TYPE

Laceration from strip edge during head end guidance; hand in line of fire of strip deflection if threading tension varies suddenly; hand caught between strip and bridge roll at nip

"During manual strip threading assistance, what specifies the maximum distance the worker's hand should approach the strip edge — and is that distance defined in the threading procedure, or left to individual judgement?"

ENGINEERING INTERFACE CONSIDERATION

Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.

• MEDIUM · EXPOSURE FREQUENCY

Bridle Roll & Tension Reel — Surface Inspection & Maintenance

CAUGHT-BETWEEN / LACERATION

WHY THE HAND IS THERE

Bridle roll surfaces wear from strip contact and require inspection. Reel mandrel segments and wrapper roll assemblies require maintenance between coils. Workers access these components in a bay where strip is under tension on adjacent equipment — and the nip between the bridge roll and the strip is present even when the specific roll being inspected is stationary.

HAND INTERFACE

Bridle roll surface, reel mandrel segment, wrapper roll body and coupling, mandrel locking key, strip edge on adjacent coil

EXPOSURE TYPE

Hand drawn into bridge roll nip if adjacent strip restarts; laceration from strip edge on adjacent coil during reel maintenance; pinch at mandrel locking key during replacement

"During bridge roll surface inspection, is the strip path through that specific roll positively isolated — or is only the roll drive isolated while tension from adjacent equipment remains on the strip path?"

ENGINEERING INTERFACE CONSIDERATION

Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.

ZONE B — SIDE TRIMMER · COOLANT HEADERS · AGC HYDRAULICS

• MEDIUM · EXPOSURE FREQUENCY

Side Trimmer — Blade Change & Scrap Chopper Maintenance

LACERATION / CRUSH

WHY THE HAND IS THERE

Side trimmer blades wear and chip and must be changed. Trim scrap — a continuous ribbon of cold-rolled strip edge — feeds through the scrap chopper continuously during production. Chopper anvil wear, blade replacement, and scrap guide jam clearing require hand access to a machine that handles extremely sharp, thin strip material under high tension. The chopper cuts trim scrap at high frequency; its blades and anvil are among the sharpest components in the cold mill.

HAND INTERFACE

Trimmer blade edge and mounting face, chopper blade and anvil, scrap guide interior, trim scrap edge during guide access

EXPOSURE TYPE

Laceration from trimmer blade edge during change; hand caught at chopper if chopper is not positively isolated during blade or anvil work; laceration from trim scrap edge during guide jam clearing

"When trim scrap guide jams are cleared, is the chopper positively isolated before the operator's hand enters the scrap path — or is the clearing done by hand with the chopper in a stopped-but-energised state?"

ENGINEERING INTERFACE CONSIDERATION

Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.

• HIGH · EXPOSURE FREQUENCY

Coolant Header — Nozzle & Spray System Maintenance

LINE-OF-FIRE / PINCH

WHY THE HAND IS THERE

Rolling emulsion delivery headers above and below the strip pass line have numerous nozzles that block or wear and require replacement between roll changes. Workers access nozzle headers in the enclosed stand environment — saturated with emulsion, with limited visibility and restricted reach. Residual pressure in the header supply system if isolation is incomplete creates a line-of-fire risk from emulsion spray directly into the face and hands.

HAND INTERFACE

Nozzle body and thread, header supply fitting, isolation valve handle, header mounting bracket, spray deflector

EXPOSURE TYPE

Hand and face in line of fire of pressurised emulsion if nozzle is removed without full pressure isolation; pinch between nozzle body and header during replacement on slippery emulsion-covered surfaces

"During coolant header nozzle replacement between roll changes, what confirms the header supply is at zero pressure at the nozzle — not just at the supply valve panel — before the nozzle is unscrewed?"

ENGINEERING INTERFACE CONSIDERATION

Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.

• MEDIUM · EXPOSURE FREQUENCY

AGC Hydraulic System — Servo Valve & Hose Maintenance

LINE-OF-FIRE / PINCH

WHY THE HAND IS THERE

AGC servo valves and hydraulic hose connections require maintenance in a very enclosed stand environment. The hydraulic system operates at high pressure. Workers access servo valve mounting faces and hose connections in the space between the stand housing and the hydraulic power pack room — often with residual strip tension on the adjacent pass and limited clearance for tools and hands simultaneously.

HAND INTERFACE

Servo valve body and mounting bolts, hydraulic hose end fitting, isolation valve handle, stand housing edge near servo valve

EXPOSURE TYPE

High-pressure hydraulic injection if hose fitting is disturbed without full circuit isolation; pinch between servo valve and housing during removal; hand struck by valve if mounting bolt releases under system residual pressure

"During AGC servo valve replacement, what confirms the hydraulic circuit — not just the local valve — is at zero pressure before the valve mounting bolts are broken?"

ENGINEERING INTERFACE CONSIDERATION

Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.

4 SHUTDOWN & OVERHAUL — ADDITIONAL EXPOSURE

LOW exposure frequency refers to how often the hand is exposed in normal operations, not to the consequence if contact occurs. Cold mill shutdowns require full strip de-threading and tensioning system isolation before stand access — additional steps that are frequently abbreviated under time pressure.

TASK	HAND EXPOSURE	FREQ.	EXPOSURE	PSC ENGINEERING INTERFACE PORTFOLIO
Backup roll change	Heavy backup roll and chock assembly crane-guided into stand window; same pattern as hot mill but in an enclosed, emulsion-wet environment with tighter clearances	LOW	CRUSH	PSC Load Control Interfaces · PSC Position & Reach Interfaces
Stand housing inspection & liner replacement	Workers enter the stand housing for liner measurement and replacement; confined space with AGC cylinder and hydraulic systems in close proximity throughout	LOW	LINE-OF-FIRE / PINCH	PSC Position & Reach Interfaces · PSC Striking & Alignment Interfaces
Full coolant header replacement	Headers removed and replaced in the enclosed stand; nozzle connection and fitting work in an emulsion-saturated environment throughout the replacement sequence	LOW	LINE-OF-FIRE	PSC Position & Reach Interfaces
Trimmer blade set replacement	Full trimmer blade set replaced; blade segment handling with laceration risk; blade clamping bolt work with holding hand in proximity to blade edge throughout	MED	LACERATION / CRUSH	PSC Load Control Interfaces · PSC Magnetic Handling Interfaces · PSC Position & Reach Interfaces · PSC Striking & Alignment Interfaces

5 CONTRACTOR & MOBILE EQUIPMENT INTERFACES

ACTIVITY / EQUIPMENT	HAND EXPOSURE SCENARIO	EXPOSURE	PSC ENGINEERING INTERFACE PORTFOLIO
Roll change crew	Work roll and backup roll changes at all stands; coupling pin work and bending block connection in emulsion-wet stand environment under time pressure	CRUSH PINCH	PSC Load Control Interfaces · PSC Position & Reach Interfaces · PSC Striking & Alignment Interfaces
Threading crew	Strip threading assistance at bridle rolls and coiler mandrel entry; direct hand proximity to moving strip edge at threading speed	LACERATION	PSC Position & Reach Interfaces
Overhead crane	Work roll and backup roll crane operations in the enclosed cold mill bay; crane guidance in tighter clearances than hot mill equivalent	CRUSH	PSC Load Control Interfaces

6 COLD ROLLING MILL QUICK ASSESSMENT CHECKLIST

Use during a plant walkdown or shutdown planning session. Answer based on current observed practice.

- ☐ During work roll changes, does the worker's hand enter the stand window area on an emulsion-wet surface — and is the rolling emulsion cleared from the critical contact points before guidance begins?
- ☐ During coupling pin driving at cold mill stands, is the holding hand clear of the strike zone throughout the pin driving sequence?
- ☐ During strip threading assistance, does any procedure specify the minimum hand-to-strip-edge distance — or is that left to individual operator judgement?
- ☐ During bridle roll inspection, is the strip path through that specific roll positively isolated — not just the roll drive motor?
- ☐ When trim scrap guide jams are cleared, is the scrap chopper positively isolated before the operator's hand enters the scrap path?
- ☐ During coolant header nozzle replacement, is zero pressure confirmed at the nozzle itself — not only at the supply panel — before the nozzle is unscrewed?
- ☐ During AGC servo valve replacement, is the hydraulic circuit confirmed at zero pressure before mounting bolts are broken?
- ☐ During backup roll changes, are anti-tangle taglines used throughout the crane approach and stand window seating sequence?

If you answered **Yes** to any of the above, PSC can review those tasks and recommend representative hands-free engineered interfaces to consider. Contact Shivani at **+91-96031-66448** or **sales@pschandsafety.com**

7 PSC ENGINEERING INTERFACE PORTFOLIO — COLD ROLLING MILL

The following PSC engineering interfaces are relevant to the hand exposure scenarios identified in this chapter. This table introduces PSC product families and their primary engineering functions. It does not map any product to a specific scenario or application.

PSC LOAD CONTROL INTERFACES		
PSC ENGINEERING INTERFACE	PRIMARY FUNCTION	REPRESENTATIVE PART NUMBERS
PSC LoadGuider® Anti-Tangle Tagline	Controls suspended loads from a safe distance during crane operations	PSC-LGTC-15 PSC-LGTC-20 PSC-LGTC-25 PSC-LGTC-30
PSC Guidelt® Safety Rigger Tagline	Provides a safe, reusable tagline interface for controlling suspended loads from a stand-off distance throughout the lifting operation	PSC-GISRT-10 PSC-GISRT-15
PSC RiggerMate® Hook	Positions slings, shackles and rigging components without direct hand contact on rigging	PSC-RMH
PSC TaglineRetriever	Retrieves tagline rope ends after load landing without the operator entering the load zone	PSC-TRT PSC-TRT-3P
PSC POSITION & REACH INTERFACES		
PSC ENGINEERING INTERFACE	PRIMARY FUNCTION	REPRESENTATIVE PART NUMBERS
PSC LoadGuider® Push/Pull Pole	Pushes and pulls loads, components and rigging at a safe standoff distance	PSC-LG-42 PSC-LG-50 PSC-LG-72 PSC-LG-96
PSC Guide-It® Push/Pull Pole	Heavy-duty extended-reach push/pull for higher-force load guidance and positioning	PSC-GIT-50 PSC-GIT-72 PSC-GIT-96
PSC Load-It® Push/Pull Tool	Positions, guides and controls components using interchangeable heads suited to specific load geometries	PSC-LIT-S004 PSC-LIT-S006 PSC-LIT-S008
PSC SafeGuider Tool	Provides controlled standoff access to confined, hot or hazardous locations during maintenance	PSC-STGT-36 PSC-STGT-48
PSC MANUAL LIFTING INTERFACES		
PSC ENGINEERING INTERFACE	PRIMARY FUNCTION	REPRESENTATIVE PART NUMBERS
PSC Lift Assist Sling — Single Handle	Provides an engineered carry interface for components without a designed grip point, within manual handling limits	HSF-SH-075
PSC Lift Assist Sling — Double Handle	Provides a two-person engineered carry interface for longer components, within manual handling limits	HSF-DH-100
PSC Lift Assist Sling — Valve & Motor	Provides an engineered carry interface for valves, small motors and small pump bodies	HSF-CV
PSC Handle-Tech Pipe Lifter	Provides an engineered grip interface for pipe and hose carry without barrel gripping or finger-beneath-pipe contact	PSC-HTL-002 PSC-HTL-004 PSC-HTL-006
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PSC Chisel & Punch Holder	Holds narrow chisels and punches during light hammer striking where a smaller holding interface is required	PSC-CPH

Selection of the appropriate engineering interface depends on the specific application, load characteristics, work method and site conditions. **Contact PSC Hand Safety India for application-specific engineering guidance and product recommendations.**

— APPLICATION-SPECIFIC ENGINEERING GUIDANCE

If any hand exposure scenario in this chapter reflects tasks in your plant or maintenance team, PSC Hand Safety India can provide application-specific engineering guidance. Bring the task, the component, the work method, and the site conditions — PSC will identify the most appropriate engineering interface for your specific application.

TO RECEIVE APPLICATION-SPECIFIC GUIDANCE, DESCRIBE:

1. The specific task or operation
2. The equipment type and component
3. The component weight and geometry
4. Whether the component is ferrous
5. The work method currently in use
6. The frequency of the task
7. The working environment and access constraints
8. Your plant name and location

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ENGINEER THE HAND OUT OF THE HAZARD™

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Continuous Annealing & Galvanising Lines

This chapter identifies typical manual hand exposure scenarios encountered in this department of an integrated steel plant and highlights representative PSC application solutions commonly used for similar industrial tasks. Final product selection should always consider the specific task, component geometry, operating environment and site risk assessment.

1 DEPARTMENT OVERVIEW

Facilitator opening: Ask the audience what the temperature of the zinc in their galvanising pot is — and then ask how close to that pot a maintenance worker's hand gets during sink roll or pot roll replacement. In most plants the answer to the first question is immediate: around 450–460°C. The answer to the second question is less certain, because pot roll replacement is planned in maintenance procedures but the actual hand interface during crane-guided roll seating is not always specified. That gap — between knowing the hazard temperature and specifying the hand position — is the starting point for this chapter.

Continuous annealing lines (CAL) and continuous hot-dip galvanising lines (HDGL or CGL) process cold-rolled strip coils through controlled thermal cycles to restore mechanical properties and, in the case of galvanising, apply a protective zinc or zinc-alloy coating. The strip travels continuously through entry loopers, furnace sections, cooling sections, and — on galvanising lines — through the zinc pot and air knife section before being coiled at exit. The lines run at high speed and are designed for minimal unplanned stops; maintenance is concentrated in planned windows between coil campaigns and during scheduled line stoppages.

From a hand safety perspective, these lines present two distinct exposure profiles. In the furnace and cooling sections — common to both CAL and HDGL — furnace rolls, tension rolls, and cooling roll maintenance involves access to hot, enclosed equipment with driven rolls in close proximity. In the galvanising pot section — specific to HDGL — sink roll and pot roll changes, air knife adjustment, snout maintenance, and zinc pot cleaning create a unique combination of molten zinc splash, line-of-fire, and crane-guided heavy component exposure found in no other department in the plant.

2 MAJOR EQUIPMENT

ENTRY SECTION — COIL LOADING & LOOPERS

Strip coils are loaded at the entry end, joined by welding or stitching, and fed through the entry looper accumulator. The looper provides continuous strip flow to the furnace during coil joins. Looper rolls, deflector rolls, and looper car mechanisms require maintenance with strip under tension at the looper entry and exit.

FURNACE SECTION — RADIANT TUBE & FURNACE ROLLS

The strip passes through a controlled-atmosphere furnace on driven ceramic or alloy furnace rolls. Furnace rolls are accessed for surface inspection and replacement through furnace doors — where plant procedures permit — in a hot, inert-atmosphere environment. Radiant tube burner connections and combustion air systems are accessed for maintenance at the furnace exterior.

COOLING SECTION — COOLING ROLLS & GAS JET NOZZLES

After annealing, the strip is cooled by contact with water-cooled rolls or by gas jet cooling nozzles. Cooling roll surfaces, bearing housings, and gas jet nozzle systems require maintenance with the furnace section immediately upstream at elevated temperature.

ZINC POT — SINK ROLL, POT ROLL & STABILISER (HDGL)

The strip enters the molten zinc pot through the snout and passes around the sink roll before exiting vertically past stabiliser rolls and pot rolls. Sink roll and pot roll changes require crane-guided replacement of roll assemblies submerged in or immediately adjacent to molten zinc at approximately 450°C. This is the highest-consequence crane guidance task in the plant.

AIR KNIFE & SNOUT (HDGL)

Air knives above the zinc pot control zinc coating weight by blowing high-pressure air across the strip surface. The snout — a sealed enclosure directing the strip into the zinc pot in a controlled atmosphere — requires periodic maintenance. Both systems are accessed in proximity to the zinc pot and require careful hand positioning relative to zinc spray and liquid zinc splash zones.

TENSION ROLLS, SKIN PASS MILL & EXIT SECTION

Tension rolls maintain strip tension throughout the line. The skin pass mill — a light reduction mill at the exit — applies surface texture and improves flatness. Tension roll surfaces, skin pass work roll changes, and exit looper roll maintenance complete the hand exposure profile for these lines.

3 MANUAL TASKS & HAND EXPOSURE SCENARIOS

ZONE A — FURNACE SECTION · COOLING ROLLS · TENSION ROLLS

• LOW · EXPOSURE FREQUENCY

Furnace Roll — Inspection & Replacement

BURNS / CRUSH / LINE-OF-FIRE

WHY THE HAND IS THERE

Furnace rolls develop build-up deposits on their surface and periodic nodule formation that damages strip surface. Inspection through furnace peepholes and replacement through furnace doors — where plant procedures permit — requires access to the furnace interior during a temperature-reduced maintenance window. Roll replacement by crane through the furnace door places hands in proximity to the furnace door opening and to the crane load in a high-temperature environment.

HAND INTERFACE

Furnace roll barrel during crane guidance into furnace, furnace door frame, crane hook at roll lifting lug, roll bearing housing during seating on furnace roll support

EXPOSURE TYPE

Burns from furnace door opening radiant heat and from roll surface; hand crushed between roll body and furnace roll support during crane-guided seating; hand in line of fire of crane hook shift during approach through furnace door

"During furnace roll replacement, at what furnace temperature is access permitted — and where is the guiding hand relative to the furnace door frame and the incoming roll during the final crane approach?"

ENGINEERING INTERFACE CONSIDERATION

Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.

• HIGH · EXPOSURE FREQUENCY

Tension Roll & Looper Roll — Surface Inspection & Bearing Maintenance

CAUGHT-BETWEEN / PINCH

WHY THE HAND IS THERE

Tension rolls throughout the line control strip tension and require surface inspection and periodic bearing maintenance. Looper rolls at the entry and exit accumulators are subject to wear. Workers access roll surfaces and bearing housings with strip under tension on the strip path through the roll — where the nip between the strip and the roll surface is present even when the specific roll drive is de-energised.

HAND INTERFACE

Tension roll surface, bearing housing face and retaining bolt, roll drive coupling, strip edge on adjacent strip path

EXPOSURE TYPE

Hand drawn into roll-strip nip if adjacent strip tension restarts; pinch at bearing housing during maintenance; laceration from strip edge during access if strip path is not positively isolated

"During tension roll bearing maintenance, is the strip tension positively relieved through the roll — not just the roll drive isolated — before any hand contacts the roll surface or bearing housing?"

ENGINEERING INTERFACE CONSIDERATION

Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.

ZONE B — ZINC POT · SINK ROLL · POT ROLL · AIR KNIFE (HDGL)

• LOW · EXPOSURE FREQUENCY

Zinc Pot — Sink Roll & Pot Roll Change

BURNS / CRUSH / MOLTEN ZINC SPLASH

WHY THE HAND IS THERE

Sink rolls and pot rolls submerged in or immediately adjacent to the molten zinc bath must be changed on a campaign basis when bearings fail or roll surfaces wear. The roll assembly is lifted by crane through the zinc bath surface — with molten zinc at approximately 450°C draining from the roll during extraction. The replacement roll is lowered into the bath by crane with workers guiding it into its bearing housings in the pot framework, in proximity to the zinc surface.

HAND INTERFACE

Crane hook and sling at roll lifting lug above zinc pot, pot framework bearing housing during guided seating, tagline on roll body during bath approach, zinc pot edge structure

EXPOSURE TYPE

Molten zinc splash burns if roll enters or exits bath surface rapidly; hand crushed between roll body and pot framework during bearing seating; hand in line of fire of crane hook if it shifts during approach above open zinc surface

"During sink roll replacement over the zinc pot, what controls the roll's lateral position during the crane-guided approach to the bath surface — and what keeps the guiding hands clear of the zinc surface at the moment of roll entry?"

ENGINEERING INTERFACE CONSIDERATION

Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.

• MEDIUM · EXPOSURE FREQUENCY

Air Knife — Adjustment, Lip Cleaning & Nozzle Maintenance

BURNS / LINE-OF-FIRE

WHY THE HAND IS THERE

Air knife lips accumulate zinc splatter and dross deposits during operation and must be cleaned and adjusted to maintain coating weight control. Workers access the air knife lip face and nozzle gap from platforms above and beside the zinc pot — in an environment where zinc splatter from the pot surface below is ongoing and the strip is running at line speed through the air knife gap when the line is at partial production speed.

HAND INTERFACE

Air knife lip face and edge, nozzle adjusting screw, dross scraper on lip face, air knife mounting bracket, zinc pot edge structure below

EXPOSURE TYPE

Burns from zinc splatter on hand during lip cleaning above the pot; hand in line of fire of high-pressure air blast if lip gap is approached during air flow; laceration from air knife lip edge during cleaning

"When air knife lips are cleaned above the zinc pot, is the air supply isolated before the cleaning tool contacts the lip face — or is cleaning performed under reduced-flow conditions with the air system still energised?"

ENGINEERING INTERFACE CONSIDERATION

Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.

• MEDIUM · EXPOSURE FREQUENCY

Snout — Maintenance & Seal Inspection

BURNS / LINE-OF-FIRE

WHY THE HAND IS THERE

The snout directs the strip from the furnace exit into the zinc bath in a sealed, controlled-atmosphere enclosure. Dross accumulates at the snout tip inside the zinc pot and must be cleared. Snout seals and the snout tip structure require inspection and maintenance — with the snout tip submerged in or immediately above the zinc surface and the snout interior at elevated temperature from the furnace connection above.

HAND INTERFACE

Snout tip body, dross scraper handle during pot edge access, snout seal face and retaining clamp, snout interior via inspection port

EXPOSURE TYPE

Burns from zinc splash during snout tip dross clearing at pot surface; burns from snout interior during seal inspection; hand in line of fire of zinc pot edge during dross removal reach-over

"During snout tip dross clearing above the zinc bath, what tool is used to reach into the bath surface zone — and how far does the operator's hand approach the zinc surface during the clearing movement?"

ENGINEERING INTERFACE CONSIDERATION

Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.

• MEDIUM · EXPOSURE FREQUENCY

Skin Pass Mill — Work Roll Change & Strip Threading

CRUSH / LACERATION

WHY THE HAND IS THERE

The skin pass mill at the line exit applies a controlled light reduction to the galvanised strip to improve flatness and surface texture. Work roll changes follow the same pattern as the cold rolling mill — crane guidance into the stand window, coupling pin work, and threading assistance after roll change. The skin pass mill is lighter and more accessible than the CRM but the hand exposure profile at the stand is identical in character.

HAND INTERFACE

Roll chock or neck during stand window guidance, coupling pin body, strip head end edge during threading assistance, stand window ledge

EXPOSURE TYPE

Hand crushed between chock and stand window during crane-guided roll insertion; impact at coupling pin with holding hand in strike zone; laceration from strip edge during threading

"During skin pass mill work roll changes, how does the roll change sequence differ from the CRM stands — and does the lighter roll weight in the skin pass mill reduce the use of taglines or guided crane control?"

ENGINEERING INTERFACE CONSIDERATION

Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.

4 SHUTDOWN & OVERHAUL — ADDITIONAL EXPOSURE

LOW exposure frequency refers to how often the hand is exposed in normal operations, not to the consequence if contact occurs. CAL/HDGL shutdowns require zinc pot drainage or solidification before major pot maintenance — a time-consuming prerequisite that concentrates pot work into short windows with high worker density.

TASK	HAND EXPOSURE	FREQ.	EXPOSURE	PSC ENGINEERING INTERFACE PORTFOLIO
Zinc pot full drainage & cleaning	After pot drainage, residual zinc and dross is removed from pot walls and floor; workers access pot interior with scrapers and high-reach tools — residual zinc retains heat for extended periods	LOW	BURNS / LACERATION	PSC Position & Reach Interfaces
Full furnace roll replacement campaign	All furnace rolls replaced in sequence through furnace doors during planned furnace cool-down; crane guidance through furnace door opening throughout the campaign	LOW	BURNS / CRUSH	PSC Load Control Interfaces · PSC Position & Reach Interfaces
Looper car & roll overhaul	Entry and exit looper rolls removed by crane for bearing replacement; looper car mechanism overhauled with strip path de-tensioned and isolated	LOW	CAUGHT-BETWEEN	PSC Load Control Interfaces · PSC Striking & Alignment Interfaces

5 CONTRACTOR & MOBILE EQUIPMENT INTERFACES

ACTIVITY / EQUIPMENT	HAND EXPOSURE SCENARIO	EXPOSURE	PSC ENGINEERING INTERFACE PORTFOLIO
Pot roll & sink roll change crew	Campaign-basis sink roll and pot roll changes above the zinc bath; crane-guided seating of roll assembly in pot framework bearing housing with zinc pot open below	BURNS CRUSH	PSC Load Control Interfaces · PSC Position & Reach Interfaces
Refractory contractor (furnace lining)	Furnace lining inspection and repair during shutdown; workers access furnace interior through doors and inspection openings with residual heat and refractory dust throughout	BURNS	PSC Position & Reach Interfaces
Overhead crane (furnace & pot area)	Furnace roll and pot roll crane operations; crane lifts above the open zinc pot surface during sink roll changes require the highest-care crane control on any CAL/HDGL	LINE-OF-FIRE	PSC Load Control Interfaces · PSC Position & Reach Interfaces

6 CAL / HDGL QUICK ASSESSMENT CHECKLIST

Use during a plant walkdown or shutdown planning session. Answer based on current observed practice.

- ☐ During furnace roll replacement by crane, is the guiding hand's position relative to the furnace door frame and the incoming roll specified in the maintenance procedure?
- ☐ During tension roll or looper roll bearing maintenance, is strip tension through the specific roll positively relieved — not just the roll drive isolated?
- ☐ During sink roll or pot roll replacement, what controls the roll's lateral position during crane-guided approach to the zinc bath surface — and are the guiding hands specified to remain clear of the zinc surface?
- ☐ During air knife lip cleaning above the zinc pot, is the air supply isolated before the cleaning tool contacts the lip face?
- ☐ During snout tip dress clearing at the zinc bath surface, what tool is used — and how close does the operator's hand approach the zinc surface during the clearing movement?
- ☐ During skin pass mill work roll changes, are anti-tangle taglines used throughout the crane approach and stand window seating sequence — even though the roll assembly is lighter than a CRM backup roll?
- ☐ During zinc pot cleaning after drainage, is the residual heat of the pot walls and floor assessed before workers enter the pot with scraping tools?
- ☐ For all crane lifts above the open zinc pot, is a dedicated tagline and pole standoff procedure in place — distinct from standard crane guidance procedures used elsewhere on the line?

If you answered **Yes** to any of the above, PSC can review those tasks and recommend representative hands-free engineered interfaces to consider. Contact Shivani at **+91-96031-66448** or **sales@pschandsafety.com**

7 PSC ENGINEERING INTERFACE PORTFOLIO — ANNEALING & GALVANISING

The following PSC engineering interfaces are relevant to the hand exposure scenarios identified in this chapter. This table introduces PSC product families and their primary engineering functions. It does not map any product to a specific scenario or application.

PSC LOAD CONTROL INTERFACES		
PSC ENGINEERING INTERFACE	PRIMARY FUNCTION	REPRESENTATIVE PART NUMBERS
PSC LoadGuider® Anti-Tangle Tagline	Controls suspended loads from a safe distance during crane operations	PSC-LGTC-15 PSC-LGTC-20 PSC-LGTC-25 PSC-LGTC-30
PSC Guidelt® Safety Rigger Tagline	Provides a safe, reusable tagline interface for controlling suspended loads from a stand-off distance throughout the lifting operation	PSC-GISRT-10 PSC-GISRT-15
PSC RiggerMate® Hook	Positions slings, shackles and rigging components without direct hand contact on rigging	PSC-RMH
PSC TaglineRetriever	Retrieves tagline rope ends after load landing without the operator entering the load zone	PSC-TRT PSC-TRT-3P
PSC POSITION & REACH INTERFACES		
PSC ENGINEERING INTERFACE	PRIMARY FUNCTION	REPRESENTATIVE PART NUMBERS
PSC LoadGuider® Push/Pull Pole	Pushes and pulls loads, components and rigging at a safe standoff distance	PSC-LG-42 PSC-LG-50 PSC-LG-72 PSC-LG-96
PSC Guide-It® Push/Pull Pole	Heavy-duty extended-reach push/pull for higher-force load guidance and positioning	PSC-GIT-50 PSC-GIT-72 PSC-GIT-96
PSC Load-It® Push/Pull Tool	Positions, guides and controls components using interchangeable heads suited to specific load geometries	PSC-LIT-S004 PSC-LIT-S006 PSC-LIT-S008
PSC SafeGuider Tool	Provides controlled standoff access to confined, hot or hazardous locations during maintenance	PSC-STGT-36 PSC-STGT-48
PSC STRIKING & ALIGNMENT INTERFACES		
PSC ENGINEERING INTERFACE	PRIMARY FUNCTION	REPRESENTATIVE PART NUMBERS
PSC FingerSaver®	Holds slogging spanners, drifts, chisels and punches during hammer striking, keeping the holding hand outside the impact zone	PSC-FS-295 PSC-FS-375 PSC-FS-850
PSC Chisel & Punch Holder	Holds narrow chisels and punches during light hammer striking where a smaller holding interface is required	PSC-CPH
Selection of the appropriate engineering interface depends on the specific application, load characteristics, work method and site conditions. Contact PSC Hand Safety India for application-specific engineering guidance and product recommendations.		

— APPLICATION-SPECIFIC ENGINEERING GUIDANCE

If any hand exposure scenario in this chapter reflects tasks in your plant or maintenance team, PSC Hand Safety India can provide application-specific engineering guidance. Bring the task, the component, the work method, and the site conditions — PSC will identify the most appropriate engineering interface for your specific application.

TO RECEIVE APPLICATION-SPECIFIC GUIDANCE, DESCRIBE:

1. The specific task or operation
2. The equipment type and component
3. The component weight and geometry
4. Whether the component is ferrous
5. The work method currently in use
6. The frequency of the task
7. The working environment and access constraints
8. Your plant name and location

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CHAPTER 17 OF 22

Structural, Rail & Heavy Section Mill

This chapter identifies typical manual hand exposure scenarios encountered in this department of an integrated steel plant and highlights representative PSC and LoadGrab® application solutions commonly used for similar industrial tasks. Final product selection should always consider the specific task, component geometry, operating environment and site risk assessment.

1 DEPARTMENT OVERVIEW

Facilitator opening: Ask the audience how many times a shift the finishing saw or cold shear in their section mill is stopped to clear a misaligned section or a saw jam — and then ask how the section is repositioned when it jams. In most plants, the answer involves direct hand contact with the section body: pushing, pulling, or levering a hot or recently cut structural section back into alignment with no tool between the hand and the steel. That contact — not the rolling, not the sawing, but the repositioning — is where the highest-frequency hand exposure occurs in this department.

The Structural, Rail and Heavy Section Mill rolls reheated blooms or billets into finished structural sections: universal beams, universal columns, channels, angles, flat bars, round and square bars, rail sections, and heavy round bar for forging. The product range is wider and the individual product weights are higher than the bar mill — finished sections may weigh several tonnes per length, and the handling, cooling bed transfer, sawing, and straightening operations involve direct engagement with heavy ferrous product throughout.

From a hand safety perspective, this department combines the roll change and guide setting exposure of the bar mill with a distinct category not seen elsewhere in the rolling division: the regular manual interaction with heavy structural sections and rail lengths during cooling bed transfer, straightening, saw operation, and the finishing bay. The LoadGrab® framework — Lift, Guide, Control, Retrieve — maps directly onto these section-handling tasks, and the interaction library now provides specific product guidance for structural components that complements the PSC range already deployed in the rolling section.

2 MAJOR EQUIPMENT

ROLLING STANDS — UNIVERSAL & EDGING

Universal stands with horizontal and vertical rolls reduce the bloom to finished section profile. Roll changes, guide settings, and coupling pin work follow the same pattern as the bar mill — but with heavier individual roll assemblies and wider stands that present more confined working conditions around the housing window.

COOLING BED & TRANSFER TABLES

Finished sections cool on a walking rake or chain cooling bed and are transferred to the cold saw or shear. Transfer table skid rails, chain drives, and section alignment stops require maintenance. Sections cooling on the bed may be repositioned manually — a direct hand-to-steel interaction with heavy, recently hot product.

COLD SAW & CROP SHEAR

RAIL SAW & END FINISHING

Cold saws cut finished sections to ordered lengths. Rail saws make precision end cuts on rail sections. Saw blade changes, guide and hold-down maintenance, and section clearance after saw jams involve hand contact with the saw area and with cut section ends.

ROLLER STRAIGHTENER

Sections are straightened in a roller or gag straightener after cooling. Straightener roll changes, guide and entry table maintenance, and section threading through the straightener are the primary hand exposure tasks — with the section under load between the straightener rolls during threading.

FINISHING BAY — STACKING & BUNDLING

Cut sections are stacked by crane or mechanical stacker, bundled, and weighed. Section stacking by crane involves the same load guidance exposure as the plate mill stacker — but with individual sections of angle, channel, or beam that may swing and contact the stacking bay structure.

GRATING & FLOORING — MILL FLOOR ACCESS

Throughout the section mill, steel gratings provide access over pits, roller tables, and cooling bed structures. Grating removal for inspection access and replacement is one of the highest-frequency Retrieve interactions in the mill floor — addressed directly in the LoadGrab® Interaction Library.

3 MANUAL TASKS & HAND EXPOSURE SCENARIOS

ZONE A — ROLLING STANDS · GUIDE SETTING · COLD SAW

• HIGH · EXPOSURE FREQUENCY

Roll Change & Coupling Pin Work — Universal Stands

CRUSH / IMPACT

WHY THE HAND IS THERE

Universal stand roll changes involve both horizontal and vertical roll assemblies — heavier individual components than the bar mill, with the vertical roll chocks accessed from the side of the housing rather than from the operating aisle. Coupling pin work at each spindle is the same struck-by exposure as the bar mill, repeated at higher roll assembly weights and in tighter housing window clearances.

HAND INTERFACE

Roll chock body during crane guidance, coupling pin body and head during driving, housing window ledge, vertical roll chock side access

EXPOSURE TYPE

Hand crushed between chock and housing window during crane approach; impact at coupling pin with holding hand in strike zone; hand in line of fire of vertical roll chock if support is released during access

GUIDE **CONTROL** "During universal stand roll changes, which housing window — horizontal or vertical — puts the worker's hand closer to the pinch zone during crane approach, and is that difference reflected in the task procedure?"

ENGINEERING INTERFACE CONSIDERATION

Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.

• MEDIUM · EXPOSURE FREQUENCY

Cold Saw — Blade Change & Section Clearance

LACERATION / CRUSH

WHY THE HAND IS THERE

Cold saw blades — typically 500–1200 mm diameter, heavy, and with extremely sharp teeth — must be changed when worn. The blade is crane-lifted off the saw arbor and a new blade positioned and secured. Section clearance after a saw jam requires the worker to move the jammed section by hand in close proximity to the blade and saw housing.

HAND INTERFACE

Saw blade periphery and face during crane-guided change, saw arbor nut, jammed section body during clearance, hold-down roll guide

EXPOSURE TYPE

Laceration from saw blade teeth during crane approach and seating; crush between blade and saw housing if blade swings; hand on section during clearance in proximity to blade

GUIDE "When the cold saw blade is lifted off the arbor by crane, how is the blade's swing controlled during the approach to the saw housing — and where are the guiding hands relative to the blade teeth at that point?"

ENGINEERING INTERFACE CONSIDERATION

Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.

ZONE B — COOLING BED · SECTION HANDLING · STRAIGHTENER

• HIGH · EXPOSURE FREQUENCY

Cooling Bed — Section Repositioning & Transfer Table Alignment

BURNS / CRUSH / LACERATION

WHY THE HAND IS THERE

Heavy sections on the cooling bed or transfer table occasionally misalign on the rakes, skid rails, or roller table stops. Workers reposition sections by hand — pushing, pulling, or levering — to clear jams and realign product for the cold saw. A structural section of angle, channel, or beam has no designed grip point; the flange, web, or leg of the section is the contact surface. Sections may still be at elevated temperature from rolling.

HAND INTERFACE

Section flange or web face during push/pull repositioning, section end during levering, cooling bed rake finger contact zone, roller table stop

EXPOSURE TYPE

Burns from elevated section temperature; laceration from section end or flange edge; crush between section body and rake finger or roller table stop during repositioning; hand in line of fire of section movement if support shifts

CONTROL "When a section jams on the cooling bed transfer table, what tool or method is used to reposition it — and how close does the worker's hand approach the section surface or the adjacent rake mechanism during that repositioning?"

ENGINEERING INTERFACE CONSIDERATION

Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.

• HIGH · EXPOSURE FREQUENCY

Finishing Bay — Crane Stacking of Sections & Rail Lengths

CRUSH / STRUCK-BY

WHY THE HAND IS THERE

Cut sections and rail lengths are stacked by crane in the finishing bay. Workers guide each section or rail length onto the stack during crane approach — with the section presenting a long, narrow profile that swings and rotates during crane travel. A rail length or heavy beam section approaching a stack at an angle must be guided into alignment with one or both hands on the section body, in the pinch zone between the incoming section and the stack below.

HAND INTERFACE

Section web or flange body during guidance, rail head or foot during guidance, crane sling leg during repositioning, stack top surface at landing

EXPOSURE TYPE

Crush between incoming section and stack if swing is not controlled; struck-by if crane hook or sling shifts during guidance; hand in pinch zone between section end and stack edge at landing

GUIDE "During crane stacking of long rail or beam sections in the finishing bay, are anti-tangle taglines used throughout the full approach and stack landing sequence — or only for the first landing of a new stack?"

ENGINEERING INTERFACE CONSIDERATION

Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.

• HIGH · EXPOSURE FREQUENCY

Mill Floor Grating — Removal & Replacement

PINCH / LACERATION · RETRIEVE

WHY THE HAND IS THERE

Steel gratings over pits, roller table runs, and cooling bed structures in the section mill are removed frequently for inspection and maintenance access. A grating resting flush in its frame has no clearance beneath it. The worker slides fingers through the mesh from above to grip and lift — placing fingers in the frame structure with the full weight of the grating bearing on them at the moment of lift. This is a classic LoadGrab® Retrieve interaction: a ferrous component with no designed grip point, lifted from a surface with no clearance.

HAND INTERFACE

Grating mesh bar inside the mesh aperture, grating frame edge, frame support ledge during replacement

EXPOSURE TYPE

Fingers crushed between grating and frame if grating releases suddenly; laceration from mesh edge during grip; hand in frame pinch zone during replacement seating

RETRIEVE "When a mill floor grating is removed for inspection access, how does the worker establish the initial grip — and do the fingers enter the space between the grating and the frame support before the grating has left its seating?"

ENGINEERING INTERFACE CONSIDERATION

Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.

• MEDIUM · EXPOSURE FREQUENCY

Structural Section — Manual Lift & Carry in Finishing Bay

CRUSH / LACERATION · LIFT

WHY THE HAND IS THERE

Short off-cuts, sample lengths, and light structural sections are carried by hand in the finishing bay between the cold saw, inspection table, and despatch area. Angle, channel, flat bar, and round bar sections have no designed carry point — the worker grips the section profile directly. Structural surfaces — particularly angle leg edges and channel flange edges — are sharp after sawing, and the instinctive grip concentrates weight on a small contact area.

HAND INTERFACE

Section flange or leg edge during carry, section web face, section end after sawing, floor surface during initial lift from stack

EXPOSURE TYPE

Laceration from cut section edge during carry; fingers beneath section if lifted from a stack with no clearance below; hand crushed between section and floor or rack if section tips during lift from stack

LIFT "When a short section off-cut is carried from the cold saw to the inspection or despatch area, what is the grip point — and does that grip place the worker's fingers on a designed surface or on a cut structural edge?"

ENGINEERING INTERFACE CONSIDERATION

Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.

4 SHUTDOWN & OVERHAUL — ADDITIONAL EXPOSURE

LOW exposure frequency refers to how often the hand is exposed in normal operations, not to the consequence if contact occurs.

TASK	HAND EXPOSURE	FREQ.	EXPOSURE	PSC ENGINEERING INTERFACE PORTFOLIO
Roll housing crane lift & change	Universal stand housing sections lifted by crane during shutdown; workers guide massive structures in confined mill aisle alongside adjacent stands	LOW	CRUSH	PSC Load Control Interfaces · PSC Position & Reach Interfaces
Cooling bed full rake replacement	All cooling bed rakes replaced sequentially; chain link and finger bolt work along the full bed length; same pattern as bar mill but heavier individual rake assemblies	LOW	CAUGHT-BETWEEN	PSC Position & Reach Interfaces · PSC Striking & Alignment Interfaces
Straightener roll replacement	Straightener rolls removed by crane for resurfacing; workers guide rolls onto the straightener bed during crane-assisted reinstallation	LOW	CRUSH / BURNS	PSC Load Control Interfaces · PSC Position & Reach Interfaces
Grating removal — full mill shutdown access	Large-scale grating removal throughout the mill for pit and sub-floor maintenance access; high cumulative Retrieve exposure across the shutdown crew from repeated finger-in-mesh lifting	MED	PINCH / LACERATION	PSC Magnetic Handling Interfaces · PSC Manual Lifting Interfaces

5 CONTRACTOR & MOBILE EQUIPMENT INTERFACES

ACTIVITY / EQUIPMENT	HAND EXPOSURE SCENARIO	EXPOSURE	PSC ENGINEERING INTERFACE PORTFOLIO
Roll change & guide crew	Universal stand roll changes and guide settings throughout production campaign; coupling pin work at all stands; heavier rolls than bar mill with wider housing window clearances to manage	CRUSH PINCH	PSC Load Control Interfaces · PSC Position & Reach Interfaces · PSC Striking & Alignment Interfaces
Finishing bay crane — section stacking	Crane stacking of all section and rail lengths throughout the production shift; long, narrow loads that swing and rotate during crane travel require consistent tagline use across every lift	CRUSH LINE-OF-FIRE	PSC Load Control Interfaces · PSC Position & Reach Interfaces
Mobile crane — structural work	Crane lifts of universal stand housings, straightener frames, and heavy structural components during shutdown; large outdoor or bay lifts with extended crane radius	CRUSH	PSC Load Control Interfaces · PSC Position & Reach Interfaces

6 STRUCTURAL & SECTION MILL QUICK ASSESSMENT CHECKLIST

Use during a plant walkdown or shutdown planning session. Answer based on current observed practice.

- ☐ During universal stand roll changes, which housing window — horizontal or vertical — places the worker's hand closer to the pinch zone during crane approach, and is that distinction in the task procedure?
- ☐ During cold saw blade changes, how is the blade's swing controlled during crane approach to the saw housing — and are the guiding hands clear of the blade teeth throughout the approach?
- ☐ When sections jam on the cooling bed or transfer table, is the repositioning done with a tool — or is the section pushed, pulled, or levered by direct hand contact?
- ☐ During crane stacking of long rail or beam sections in the finishing bay, are anti-tangle taglines used for every lift — not only the first landing of a new stack?
- ☐ When mill floor gratings are removed for maintenance access, do the worker's fingers enter the mesh or the frame gap before the grating has left its seating?
- ☐ When short section off-cuts are carried from the cold saw, is the grip on a designed surface — or on a cut structural edge (flange tip, angle leg edge, channel lip)?
- ☐ During shutdown grating removal across the mill floor, is the cumulative Retrieve exposure tracked at crew level — not assessed only at the individual grating removal task?
- ☐ During straightener roll reinstallation by crane, are taglines used throughout the approach and roll-bed seating sequence?

If you answered **Yes** to any of the above, PSC can review those tasks and recommend representative hands-free engineered interfaces to consider. Contact Shivani at **+91-96031-66448** or **sales@pschandsafety.com**

7 PSC ENGINEERING INTERFACE PORTFOLIO — STRUCTURAL, RAIL & HEAVY SECTION MILL

The following PSC engineering interfaces are relevant to the hand exposure scenarios identified in this chapter. This table introduces PSC product families and their primary engineering functions. It does not map any product to a specific scenario or application.

PSC LOAD CONTROL INTERFACES		
PSC ENGINEERING INTERFACE	PRIMARY FUNCTION	REPRESENTATIVE PART NUMBERS
PSC LoadGuider® Anti-Tangle Tagline	Controls suspended loads from a safe distance during crane operations	PSC-LGTC-15 PSC-LGTC-20 PSC-LGTC-25 PSC-LGTC-30
PSC Guidelt® Safety Rigger Tagline	Provides a safe, reusable tagline interface for controlling suspended loads from a stand-off distance throughout the lifting operation	PSC-GISRT-10 PSC-GISRT-15
PSC RiggerMate® Hook	Positions slings, shackles and rigging components without direct hand contact on rigging	PSC-RMH
PSC TaglineRetriever	Retrieves tagline rope ends after load landing without the operator entering the load zone	PSC-TRT PSC-TRT-3P
PSC POSITION & REACH INTERFACES		
PSC ENGINEERING INTERFACE	PRIMARY FUNCTION	REPRESENTATIVE PART NUMBERS
PSC LoadGuider® Push/Pull Pole	Pushes and pulls loads, components and rigging at a safe standoff distance	PSC-LG-42 PSC-LG-50 PSC-LG-72 PSC-LG-96
PSC Guide-It® Push/Pull Pole	Heavy-duty extended-reach push/pull for higher-force load guidance and positioning	PSC-GIT-50 PSC-GIT-72 PSC-GIT-96
PSC Load-It® Push/Pull Tool	Positions, guides and controls components using interchangeable heads suited to specific load geometries	PSC-LIT-S004 PSC-LIT-S006 PSC-LIT-S008
PSC SafeGuider Tool	Provides controlled standoff access to confined, hot or hazardous locations during maintenance	PSC-STGT-36 PSC-STGT-48
PSC MANUAL LIFTING INTERFACES		
PSC ENGINEERING INTERFACE	PRIMARY FUNCTION	REPRESENTATIVE PART NUMBERS
PSC Lift Assist Sling — Single Handle	Provides an engineered carry interface for components without a designed grip point, within manual handling limits	HSF-SH-075
PSC Lift Assist Sling — Double Handle	Provides a two-person engineered carry interface for longer components, within manual handling limits	HSF-DH-100
PSC Lift Assist Sling — Valve & Motor	Provides an engineered carry interface for valves, small motors and small pump bodies	HSF-CV
PSC Handle-Tech Pipe Lifter	Provides an engineered grip interface for pipe and hose carry without barrel gripping or finger-beneath-pipe contact	PSC-HTL-002 PSC-HTL-004 PSC-HTL-006
PSC EzyLift Pipe Lifting Tool	Provides a wrist-neutral lift interface for pipe and bar sections from floor or rack surfaces	PSC-EZYLFT

PSC Engineering Interface Portfolio — continued

PSC STRIKING & ALIGNMENT INTERFACES		
PSC ENGINEERING INTERFACE	PRIMARY FUNCTION	REPRESENTATIVE PART NUMBERS
PSC FingerSaver®	Holds slogging spanners, drifts, chisels and punches during hammer striking, keeping the holding hand outside the impact zone	PSC-FS-295 PSC-FS-375 PSC-FS-850
PSC Chisel & Punch Holder	Holds narrow chisels and punches during light hammer striking where a smaller holding interface is required	PSC-CPH

PSC MAGNETIC HANDLING INTERFACES		
PSC ENGINEERING INTERFACE	PRIMARY FUNCTION	REPRESENTATIVE PART NUMBERS
PSC Magnetic Lifter — Standard	Lifts and retrieves ferrous components from surfaces without fingers beneath the load	HSF-MG004 HSF-MG005
PSC MagHead Lifter	Retrieves ferrous components from confined or restricted locations with 360°/180° articulation	HSF-LG-001
PSC Magnetic Hand Lifter	Retrieves small ferrous components, sheet metal and freshly cut plate from surfaces	HSF-LG-MHL
PSC Multi-Grab Magnetic Handler	Handles individual ferrous components on workshop floors and decks with 360° rotation and lever release	MG004

Selection of the appropriate engineering interface depends on the specific application, load characteristics, work method and site conditions. **Contact PSC Hand Safety India for application-specific engineering guidance and product recommendations.**

— APPLICATION-SPECIFIC ENGINEERING GUIDANCE

If any hand exposure scenario in this chapter reflects tasks in your plant or maintenance team, PSC Hand Safety India can provide application-specific engineering guidance. Bring the task, the component, the work method, and the site conditions — PSC will identify the most appropriate engineering interface for your specific application.

TO RECEIVE APPLICATION-SPECIFIC GUIDANCE, DESCRIBE:

1. The specific task or operation
2. The equipment type and component
3. The component weight and geometry
4. Whether the component is ferrous
5. The work method currently in use
6. The frequency of the task
7. The working environment and access constraints
8. Your plant name and location

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Mechanical Maintenance & Engineering

This chapter identifies typical manual hand exposure scenarios encountered in this department of an integrated steel plant and highlights representative PSC and LoadGrab® application solutions commonly used for similar industrial tasks. Final product selection should always consider the specific task, component geometry, operating environment and site risk assessment.

1 DEPARTMENT OVERVIEW

Facilitator opening: Every chapter in this manual has described maintenance hand exposure in a specific department — the blast furnace, the caster, the hot strip mill. A central mechanical maintenance team was behind most of those tasks. They are the people who travel to the department, carry the tools, install the components, and return the equipment to production. Ask the audience: of all the hand injuries on your site in the last two years, how many were in a named production department — and how many were to a maintenance tradesperson who had entered that department to do a repair? In most plants, the maintenance crew accounts for a disproportionate share of the injury count, not because they are less careful, but because they interact with the widest range of equipment, in the widest range of conditions, under the most variable isolation states.

The Central Mechanical Maintenance and Engineering function provides planned and breakdown maintenance across every department in the integrated plant. Unlike a production department, it has no fixed process flow — the team goes where the equipment failure is. A day's work may include pump removal in the water treatment plant, gearbox alignment at the hot strip mill, valve replacement in the blast furnace tapping bay, and conveyor idler replacement on the raw material handling belt — each in a different thermal, chemical, and mechanical environment.

Scope note: This chapter focuses on the maintenance interaction itself — the moment the tradesperson's hand contacts the component — for equipment types that are ubiquitous across the plant. Where department-specific context materially changes the exposure, this chapter cross-references the relevant earlier chapter rather than repeating its content. The central maintenance team encounters every scenario in this manual; this chapter covers what is common to them all.

2 EQUIPMENT TYPES — CENTRAL MECHANICAL SCOPE

PUMPS & MECHANICAL SEALS

Process, cooling water, and hydraulic pumps across all departments. Removal, carry, alignment, and reinstallation. Mechanical seal replacement on pump shafts — the most precision-demanding hand task in routine pump maintenance. Pump casing gripping during both manual and mechanical lifting. → See also Section 3, Scenario 1.

GEARBOXES & COUPLINGS

Drive gearboxes throughout the plant on conveyors, fans, pumps, and rolling mill auxiliaries. Removal, inspection, and reinstallation with coupling alignment. Coupling pin and key work during drive engagement. → Coupling pin work cross-referenced in Ch.10–13 (rolling mills). This chapter covers gearbox handling and coupling alignment as a generic task.

BEARINGS & SHAFTS

Bearing replacement on driven equipment across all departments. Bearing race driving with hammer and drift — the most consistent struck-by exposure in mechanical maintenance. Shaft handling and installation into housings. → Bearing race driving in Roll Shop (Ch.14) is the highest-volume occurrence; this chapter covers the generic task as it occurs in field maintenance.

VALVES & PIPE SPOOLS

Isolation valves, control valves, and process valves on gas, water, steam, and hydraulic lines throughout the plant. Removal from pipework, carry to workshop, and reinstallation with flange bolt-up. Flange bolt-hole alignment is the highest hand-in-pinch-zone exposure in valve and spool work.

CONVEYOR IDLERS, CHAIN DRIVES & FAN BLADES

Conveyor idler replacement on process and raw material belts throughout the plant. Drive chain maintenance on conveyor drives, fan drives, and auxiliary equipment. Fan blade inspection and replacement on process fans. → Conveyor and cooling bed chain work cross-referenced in Ch.01, Ch.03, Ch.12.

HYDRAULIC CYLINDERS & COMPRESSORS

Hydraulic cylinder replacement and seal overhaul on process equipment throughout the plant. Compressor valve plate replacement and general compressor maintenance. → Hydraulic cylinder work cross-referenced in Ch.10 (HSM AGC), Ch.11 (Plate Mill), Ch.15 (CRM). This chapter covers the generic cylinder extraction and carry task.

3 MANUAL TASKS & HAND EXPOSURE SCENARIOS

ZONE A — ROTATING EQUIPMENT: PUMPS, GEARBOXES & BEARINGS

• HIGH · EXPOSURE FREQUENCY

Pump Removal, Carry & Base-plate Reinstallation

CRUSH / PINCH · LIFT / GUIDE / CONTROL

WHY THE HAND IS THERE

Pumps are removed from their base plates and carried to the workshop or a lay-down area for seal or impeller work, then returned and reinstalled. Small to medium pumps are within the manual handling range. The pump casing has no designed carry point — workers grip the casing body or the cooling fins. During mechanical reinstallation, hands are in the pinch zone between the pump casing and the base plate structure during the final stud alignment movement. → See LoadGrab® Interaction Library: Pumps

HAND INTERFACE

Pump casing body or cooling fins during carry; base plate stud zone during alignment; mechanical seal housing during seal work on shaft

EXPOSURE TYPE

Laceration from cooling fin edge during carry; hand crushed between casing and base plate during stud entry if pump pivots on first stud; hand in line of fire if pump drops during crane-assisted lowering

LIFT **CONTROL** "During pump reinstallation onto the base plate, what keeps the pump casing clear of the base plate structure while the first stud is engaged — and where are the hands at the moment the pump seats on the first stud?"

ENGINEERING INTERFACE CONSIDERATION

Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.

• HIGH · EXPOSURE FREQUENCY

Gearbox Alignment & Coupling Connection

CRUSH / PINCH · CONTROL

WHY THE HAND IS THERE

After a gearbox is returned to its base plate following maintenance, shaft coupling alignment requires fine lateral and rotational adjustment of the gearbox body. Workers push and pull the gearbox casing by hand to achieve dial gauge alignment — a sustained Control interaction against an irregular casting surface, often at operating temperature from a recent run. Once aligned, the coupling halves must be brought together and the coupling key or pin driven.

HAND INTERFACE

Gearbox housing face during lateral push/pull; coupling half face during engagement; coupling key or pin body during driving; dial gauge bracket during measurement

EXPOSURE TYPE

Hand crushed between gearbox housing and base plate structure if gearbox drops into shim gap during push; coupling pin impact with holding hand in strike zone during key driving; pinch between coupling halves during engagement

CONTROL "During gearbox coupling alignment, is the adjustment force applied by hand directly on the gearbox housing — or through a tool that keeps the hand clear of the pinch zone between the housing and the base plate structure?"

ENGINEERING INTERFACE CONSIDERATION

Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.

ZONE A — ROTATING EQUIPMENT: PUMPS, GEARBOXES & BEARINGS (CONTINUED)		
• HIGH • EXPOSURE FREQUENCY		
Bearing Race Driving — Field Replacement	IMPACT / CRUSH • CONTROL	
WHY THE HAND IS THERE Bearing replacement on driven equipment throughout the plant — conveyor drives, fans, pumps, gearbox output shafts — requires hammer-and-drift driving of the bearing inner race onto the shaft in the field, where a hydraulic press is not always available. The drift must be held against the bearing race face during hammer blows. This is the single most consistent struck-by exposure in field mechanical maintenance, occurring across every department in the plant. → Roll Shop bearing race driving (high-volume, in-workshop) covered in Ch.14. This scenario covers the field equivalent.	HAND INTERFACE Bearing drift body during hammer blow, shaft end surface, bearing race inner face, housing bore edge during race seating	EXPOSURE TYPE Hand struck by hammer if drift slips or aim is off; crush between drift and shaft if drift body collapses; pinch between bearing race and housing bore during seating approach
CONTROL "When a bearing race is driven in the field with hammer and drift, what holds the drift against the race face during each blow — and is the holding hand clear of the hammer strike path?"		
ENGINEERING INTERFACE CONSIDERATION Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.		

ZONE B — VALVES, PIPE SPOOLS & CONVEYOR IDLERS

• HIGH · EXPOSURE FREQUENCY

Valve & Pipe Spool — Removal, Carry & Flange Bolt-up

CRUSH / PINCH · LIFT / CONTROL

WHY THE HAND IS THERE

Valves and pipe spools are removed from service pipework and reinstalled during planned maintenance and isolations across the plant. The valve body has no designed carry point — the handwheel is an operating mechanism, not a lifting handle. During reinstallation, both flange faces must be aligned simultaneously with bolt holes, and the worker's hand enters the pinch zone between the valve flange and the mating pipe flange during that alignment. Small to medium valves are within the manual handling range. → See LoadGrab® Interaction Library: Valves · Flanges and Spools

HAND INTERFACE

Valve casing body or handwheel during carry; flange face and bolt-hole zone during reinstallation alignment; gasket face during seating

EXPOSURE TYPE

Laceration from valve body edge or flange raised face during carry; hand crushed between flange faces if valve slips as first bolt is started; hand pinched at bolt-hole zone during alignment with mating flange

LIFT **CONTROL** "During valve reinstallation, how is the valve flange held against the mating flange face while the first bolt is started — and where are the hands relative to the pinch zone between the two flange faces at that moment?"

ENGINEERING INTERFACE CONSIDERATION

Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.

• HIGH · EXPOSURE FREQUENCY

Conveyor Idler — Replacement in Frame

CRUSH / PINCH · LIFT / RETRIEVE

WHY THE HAND IS THERE

Conveyor idler replacement is one of the highest-frequency maintenance tasks across the plant — from the raw material handling belts (Ch.01) to the finished product despatch conveyors. The idler must be lifted clear of its mounting brackets, which sit close to the belt. The worker reaches into the constrained space between belt and frame with both hands to grip the idler shell — a rotating surface that may spin under the grip. Most standard idlers weigh 5–25 kg, within the manual handling range. → See LoadGrab® Interaction Library: Conveyor Idlers. RMHP conveyor maintenance also in Ch.01.

HAND INTERFACE

Idler shell during extraction from frame bracket; idler end cap or journal during carry; mounting bracket edge during replacement seating

EXPOSURE TYPE

Hand caught between idler shell and frame bracket during extraction; idler seized on bearing releases suddenly with hands gripping shell; laceration from bracket edge during replacement seating

RETRIEVE **LIFT** "During conveyor idler replacement, how is the idler gripped to extract it from the frame bracket — and where are the worker's hands relative to the belt and bracket at the moment the idler breaks free from a seized bearing?"

ENGINEERING INTERFACE CONSIDERATION

Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.

ZONE B — CONVEYOR IDLERS & PIPE HANDLING (CONTINUED)		
• MEDIUM • EXPOSURE FREQUENCY		
Pipe Lifting & Carry — Field Pipework Installation	CRUSH / STRAIN • LIFT	
WHY THE HAND IS THERE Central maintenance crews install and replace pipework across the plant — process lines, cooling water, hydraulic and compressed air runs. Pipes are carried from the fabrication yard to the installation point, lifted into position, and held for welding or flange connection. A pipe resting on a rack or cradle has no grip point — workers slide fingers beneath it and lift from below, placing fingers between the pipe and the surface at the moment of maximum loading. → See LoadGrab® Interaction Library: Pipes	HAND INTERFACE Pipe barrel during carry from below; pipe end during alignment to fitting; rack surface during initial lift with fingers beneath pipe	EXPOSURE TYPE Fingers crushed between pipe and rack if pipe rolls during initial lift; strain on wrist and hand from sustained carry without a designed grip; laceration from pipe end bevel or cut edge during positioning
LIFT "When a pipe section is lifted from a rack or the floor to carry it to the installation point, are fingers entering the space below the pipe before it has left the rack — and does the pipe have a designed interface for the carry, or is it gripped by the barrel?"		
ENGINEERING INTERFACE CONSIDERATION Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.		

ZONE C — FANS, HYDRAULIC CYLINDERS & MECHANICAL SEALS

• MEDIUM · EXPOSURE FREQUENCY

Fan Blade — Inspection & Replacement

STRUCK-BY / CRUSH · CONTROL

WHY THE HAND IS THERE

Process fans throughout the plant — for furnace combustion air, cooling, dust extraction, and ventilation — have fan blades that wear, crack, or become unbalanced. Blade replacement requires access into the fan housing with the rotor locked against rotation. Workers reach into the fan housing to reach the blade root and blade tip retaining bolts — with the blade edge close to the housing wall throughout the work. → Stelmor fan maintenance covered in Ch.13 (WRM). This scenario covers the generic plant-wide fan blade task.

HAND INTERFACE

Fan blade tip and root face, retaining bolt head, fan housing edge during access, rotor hub body

EXPOSURE TYPE

Hand struck by blade if rotor is not mechanically locked during access; laceration from blade tip or housing edge; crush between blade and housing wall if blade is rotated during removal

CONTROL "During fan blade replacement, is the rotor mechanically locked against any rotation — not just de-energised at the panel — before the worker's hand enters the fan housing to reach the blade root or tip bolts?"

ENGINEERING INTERFACE CONSIDERATION

Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.

• HIGH · EXPOSURE FREQUENCY

Hydraulic Cylinder — Field Extraction & Seal Replacement

LINE-OF-FIRE / CRUSH · RETRIEVE

WHY THE HAND IS THERE

Hydraulic cylinders throughout the plant require seal replacement and periodic cylinder extraction for rebuild. The cylinder body is smooth chrome or steel — no designed grip point. Extraction from a confined location within a machine frame requires the hand to enter the space around the cylinder body before the cylinder can be gripped for carry. Residual hydraulic pressure if isolation is incomplete creates a line-of-fire risk at the port connection. → AGC hydraulic cylinder work covered in Ch.10 (HSM), Ch.11 (PM), Ch.15 (CRM). This scenario covers the generic field extraction task.

HAND INTERFACE

Cylinder body during grip-and-carry; port connection during hose disconnection; cylinder mounting bracket during extraction from frame

EXPOSURE TYPE

High-pressure hydraulic injection if port fitting is disturbed without zero-pressure confirmation; crush if cylinder moves when mounting bolt releases; fingers beneath cylinder if it drops during extraction

RETRIEVE "During hydraulic cylinder extraction from its mounting, what confirms zero pressure in the cylinder circuit — not just at the panel valve — before the port fittings are broken and before the mounting bolts are fully released?"

ENGINEERING INTERFACE CONSIDERATION

Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.

ZONE C — MECHANICAL SEALS (CONTINUED)		
• HIGH · EXPOSURE FREQUENCY		
Mechanical Seal Replacement on Pump Shaft		PINCH / IMPACT · CONTROL
WHY THE HAND IS THERE Mechanical seal replacement is a core planned maintenance task on process and cooling water pumps across every department. The seal faces, spring carrier, and seal ring must be fitted onto the shaft with precise axial positioning. The seal ring is driven to its seat position by tapping with a sleeve or bush — with the holding hand steadying the sleeve on the shaft. The spring carrier and rotating element require precise hand placement around the shaft while the assembly is slid into the seal housing bore. This is a high-skill, high-hand-exposure task performed many times per week across the plant.	HAND INTERFACE Seal face and spring carrier body during assembly; drive sleeve face during tapping into position; shaft surface during seal ring slide; seal housing bore edge	EXPOSURE TYPE Hand struck at drive sleeve during tapping; pinch between seal face and housing bore during assembly; laceration from seal face edge if seal rotates unexpectedly during fitting
CONTROL "During mechanical seal ring driving onto the pump shaft, what holds the drive sleeve against the seal face during each tap — and is the holding hand clear of the striking line throughout the seating sequence?"		
ENGINEERING INTERFACE CONSIDERATION Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.		

ZONE D — CHAIN DRIVES, JACKING OPERATIONS & BOLT TORQUING

• HIGH · EXPOSURE FREQUENCY

Drive Chain — Link Pin Removal & Replacement

CAUGHT-BETWEEN / IMPACT · CONTROL

WHY THE HAND IS THERE

Drive chain maintenance on conveyor drives, fan drives, pump drives, and auxiliary equipment throughout the plant involves chain link pin removal and replacement. The chain link pin must be held against the chain face while it is driven out or in — with the holding hand between the punch and the chain link on every blow. Chain drives under residual tension may move unexpectedly when a link pin is removed and the chain slack is taken up. → Cooling bed chain work covered in Ch.03 (SP), Ch.11 (PM), Ch.12 (BRM). This scenario covers the generic drive chain task across all departments.

HAND INTERFACE

Chain link pin during driving, chain link plate surface, sprocket tooth face during chain tensioning, chain tensioner screw

EXPOSURE TYPE

Hand struck by hammer when holding punch at link pin; hand caught between chain and sprocket if drive restarts; finger pinched at link plate during link assembly

CONTROL "When a drive chain link pin is removed or replaced, is the holding hand gripping the punch directly — or is the punch held by a tool that keeps the hand clear of the hammer strike zone?"

ENGINEERING INTERFACE CONSIDERATION

Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.

• MEDIUM · EXPOSURE FREQUENCY

Jacking Operations & Heavy Component Positioning

CRUSH / STRUCK-BY · GUIDE / CONTROL

WHY THE HAND IS THERE

Heavy components — gearboxes, motor frames, compressor blocks — are jacked for shimming, base plate levelling, and foundation bolt work. Workers guide shim plates into position under the jacked component with one hand while the jack is operated. The shim is inserted in the space between the component base and the support structure — the pinch zone if the jack is lowered or releases unexpectedly. Equally, a component being jacked sideways into alignment may trap the guiding hand between the component base and the surrounding structure.

HAND INTERFACE

Shim plate edge during insertion below jacked component; component base and support structure at shim zone; jack handle during pumping while other hand holds shim

EXPOSURE TYPE

Hand crushed in shim zone if jack releases during shim insertion; struck-by from component movement if lateral jack slips; hand between component and structure during base bolt work

CONTROL "When a shim plate is inserted under a jacked component, is the shim guided into position by a tool — or does the worker's hand enter the space between the component base and the support structure while the component is elevated on the jack?"

ENGINEERING INTERFACE CONSIDERATION

Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.

ZONE D — CHAIN DRIVES, JACKING OPERATIONS & BOLT TORQUING (CONTINUED)		
• HIGH · EXPOSURE FREQUENCY		
Slogging Spanner & Bolt Torquing — Large Fasteners		IMPACT · CONTROL
WHY THE HAND IS THERE	HAND INTERFACE	EXPOSURE TYPE
Large flange bolts, foundation bolts, and structural fasteners throughout the plant are tightened with slogging spanners — open-jaw spanners struck with a hammer to achieve the required torque. The spanner is held on the bolt head or nut with one hand while the other swings the hammer. This is the most common single-task cause of hand injury in central mechanical maintenance across the plant — the holding hand is in the strike zone on every blow, and spanner slip under the hammer blow concentrates the full hammer force on the holding hand.	Slogging spanner body at jaw, bolt head or nut face, hammer head on spanner strike face	Hand struck by hammer if spanner slips off bolt head during the blow; hand struck if hammer misses the spanner strike face; spanner recoil onto holding hand if bolt head is rounded
CONTROL "When a slogging spanner is used for large fastener tightening, is the spanner held on the bolt head by hand — and what prevents the holding hand from being in the hammer strike path if the spanner slips?"		
ENGINEERING INTERFACE CONSIDERATION Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.		

4 SHUTDOWN & OVERHAUL — ADDITIONAL EXPOSURE

LOW frequency here means infrequent in normal operations, not low consequence. Annual plant shutdowns concentrate every department's maintenance backlog into a single compressed campaign — the central mechanical team's highest-exposure period across the year.

TASK	HAND EXPOSURE	FREQ.	EXPOSURE	PSC ENGINEERING INTERFACE PORTFOLIO
Motor removal & reinstallation — all sizes	Small frame motors carried by cooling fins; medium motors crane-lifted; coupling alignment of all motor sizes requires sustained Control interaction against the motor frame during dial-gauge alignment	LOW	CRUSH / LACERATION	PSC Load Control Interfaces · PSC Manual Lifting Interfaces
Compressor valve plate replacement	Valve plate removal and reinstallation in compressor cylinder heads; heavy cylinder head lifting onto compressor body; valve plate seating with gasket alignment requiring both hands in the bolt-up zone	LOW	CRUSH / PINCH	PSC Manual Lifting Interfaces · PSC Striking & Alignment Interfaces
Gas cylinder repositioning — maintenance yard	Gas cylinders (oxygen, acetylene, LPG) repositioned across maintenance yard and workshop; tip-over and crush risk during movement; manual dragging and tilting without a designed grip	MED	CRUSH / IMPACT	PSC Specialised Maintenance Interfaces
Steel plate & structural section handling in workshop	Plates and sections moved across the workshop floor for welding, cutting, and fabrication preparation; Retrieve from stacks and racks with fingers beneath load; Control during welding	MED	PINCH / LACERATION	PSC Magnetic Handling Interfaces · PSC Manual Lifting Interfaces

5 CONTRACTOR & SPECIALIST INTERFACES

ACTIVITY	HAND EXPOSURE SCENARIO	EXPOSURE	PSC ENGINEERING INTERFACE PORTFOLIO
Shutdown mechanical contractor crew	The highest-density hand exposure window in the plant — all equipment types, all departments, all trades simultaneously. Bearing driving, slogging, valve bolt-up, pipe lifting, and crane guidance all occurring concurrently across the crew	IMPACT PINCH LINE-OF-FIRE	PSC Manual Lifting Interfaces · PSC Striking & Alignment Interfaces
Precision alignment contractor (laser)	Laser alignment technicians making final coupling adjustments; sustained Control interaction against gearbox and motor frames; same jacking and shimming exposure as in-house crew	CRUSH	PSC Manual Lifting Interfaces · PSC Position & Reach Interfaces
Overhead crane — workshop & bay	All crane-assisted component extractions and reinstallations across the maintenance bay and in-situ throughout the plant; tagline use is the single most deployable intervention across the full contractor scope	CRUSH	PSC Load Control Interfaces

6 MECHANICAL MAINTENANCE QUICK ASSESSMENT CHECKLIST

Use during a maintenance crew toolbox talk, shutdown planning session, or task risk assessment. Answer based on current observed practice.

- ☐ When a pump is reinstalled onto its base plate, are both hands clear of the pinch zone between the casing and the base plate structure at the moment the first mounting stud is engaged?
- ☐ During gearbox coupling alignment, is the adjustment force applied through a tool — or by hand directly against the gearbox housing?
- ☐ During field bearing race driving with hammer and drift, is the drift held by a FingerSaver® or equivalent tool — rather than gripped bare-handed during each hammer blow?
- ☐ During valve or flange reinstallation, are the hands in the pinch zone between flange faces at the moment the first bolt is started?
- ☐ During conveyor idler extraction from its frame bracket, is the idler gripped with a designed sling interface — or by the shell directly, with fingers in the frame bracket zone?
- ☐ When pipe sections are lifted from racks or the floor, do fingers enter the space beneath the pipe before it has left the rack surface?
- ☐ Before any hydraulic cylinder port fitting is broken, is zero pressure confirmed at the work point — not only at the system isolation panel?
- ☐ When a mechanical seal ring is tapped onto a pump shaft, is the drive sleeve held by a FingerSaver® or equivalent — not bare-handed — during each tapping blow?
- ☐ When a fan rotor is accessed for blade replacement, is the rotor mechanically locked — not just de-energised — before any hand enters the fan housing?
- ☐ When shims are inserted under a jacked component, is the shim guided by a tool — or does the hand enter the space between the component base and the support surface while the component is elevated?
- ☐ When a slogging spanner is used for large fastener tightening, is the spanner held by a FingerSaver® or equivalent — not bare-handed — during each hammer blow?
- ☐ When drive chain link pins are removed or replaced, is the holding punch gripped by a tool — not bare-handed — during each driving blow?

If you answered **Yes** to any of the above, PSC can review those tasks and recommend representative hands-free engineered interfaces to consider. Contact Shivani at **+91-96031-66448** or **sales@pschandsafety.com**

7 PSC ENGINEERING INTERFACE PORTFOLIO — MECHANICAL MAINTENANCE & ENGINEERING

The following PSC engineering interfaces are relevant to the hand exposure scenarios identified in this chapter. This table introduces PSC product families and their primary engineering functions. It does not map any product to a specific scenario or application.

PSC LOAD CONTROL INTERFACES		
PSC ENGINEERING INTERFACE	PRIMARY FUNCTION	REPRESENTATIVE PART NUMBERS
PSC LoadGuider® Anti-Tangle Tagline	Controls suspended loads from a safe distance during crane operations	PSC-LGTC-15 PSC-LGTC-20 PSC-LGTC-25 PSC-LGTC-30
PSC Guidelt® Safety Rigger Tagline	Provides a safe, reusable tagline interface for controlling suspended loads from a stand-off distance throughout the lifting operation	PSC-GISRT-10 PSC-GISRT-15
PSC RiggerMate® Hook	Positions slings, shackles and rigging components without direct hand contact on rigging	PSC-RMH
PSC TaglineRetriever	Retrieves tagline rope ends after load landing without the operator entering the load zone	PSC-TRT PSC-TRT-3P
PSC POSITION & REACH INTERFACES		
PSC ENGINEERING INTERFACE	PRIMARY FUNCTION	REPRESENTATIVE PART NUMBERS
PSC LoadGuider® Push/Pull Pole	Pushes and pulls loads, components and rigging at a safe standoff distance	PSC-LG-42 PSC-LG-50 PSC-LG-72 PSC-LG-96
PSC Guide-It® Push/Pull Pole	Heavy-duty extended-reach push/pull for higher-force load guidance and positioning	PSC-GIT-50 PSC-GIT-72 PSC-GIT-96
PSC Load-It® Push/Pull Tool	Positions, guides and controls components using interchangeable heads suited to specific load geometries	PSC-LIT-S004 PSC-LIT-S006 PSC-LIT-S008
PSC SafeGuider Tool	Provides controlled standoff access to confined, hot or hazardous locations during maintenance	PSC-STGT-36 PSC-STGT-48
PSC MANUAL LIFTING INTERFACES		
PSC ENGINEERING INTERFACE	PRIMARY FUNCTION	REPRESENTATIVE PART NUMBERS
PSC Lift Assist Sling — Single Handle	Provides an engineered carry interface for components without a designed grip point, within manual handling limits	HSF-SH-075
PSC Lift Assist Sling — Double Handle	Provides a two-person engineered carry interface for longer components, within manual handling limits	HSF-DH-100
PSC Lift Assist Sling — Valve & Motor	Provides an engineered carry interface for valves, small motors and small pump bodies	HSF-CV
PSC Handle-Tech Pipe Lifter	Provides an engineered grip interface for pipe and hose carry without barrel gripping or finger-beneath-pipe contact	PSC-HTL-002 PSC-HTL-004 PSC-HTL-006
PSC EzyLift Pipe Lifting Tool	Provides a wrist-neutral lift interface for pipe and bar sections from floor or rack surfaces	PSC-EZYLFT

PSC Engineering Interface Portfolio — continued

PSC STRIKING & ALIGNMENT INTERFACES		
PSC ENGINEERING INTERFACE	PRIMARY FUNCTION	REPRESENTATIVE PART NUMBERS
PSC FingerSaver®	Holds slogging spanners, drifts, chisels and punches during hammer striking, keeping the holding hand outside the impact zone	PSC-FS-295 PSC-FS-375 PSC-FS-850
PSC Chisel & Punch Holder	Holds narrow chisels and punches during light hammer striking where a smaller holding interface is required	PSC-CPH
PSC MAGNETIC HANDLING INTERFACES		
PSC ENGINEERING INTERFACE	PRIMARY FUNCTION	REPRESENTATIVE PART NUMBERS
PSC Magnetic Lifter — Standard	Lifts and retrieves ferrous components from surfaces without fingers beneath the load	HSF-MG004 HSF-MG005
PSC MagHead Lifter	Retrieves ferrous components from confined or restricted locations with 360°/180° articulation	HSF-LG-001
PSC Magnetic Hand Lifter	Retrieves small ferrous components, sheet metal and freshly cut plate from surfaces	HSF-LG-MHL
PSC Multi-Grab Magnetic Handler	Handles individual ferrous components on workshop floors and decks with 360° rotation and lever release	MG004
PSC SPECIALISED MAINTENANCE INTERFACES		
PSC ENGINEERING INTERFACE	PRIMARY FUNCTION	REPRESENTATIVE PART NUMBERS
PSC GasGrab® Cylinder Mover	Moves gas cylinders without tilt-and-roll, protecting the valve and removing the hand from the cylinder body	PSC-GG-152 PSC-GG-230 PSC-GG-254
PSC Grappler Hook Tool	Engages chains, hooks and lashing components without fingers in the hook or link zone	PSC-GRA001-28 PSC-GRA001-40
Selection of the appropriate engineering interface depends on the specific application, load characteristics, work method and site conditions. Contact PSC Hand Safety India for application-specific engineering guidance and product recommendations.		

— APPLICATION-SPECIFIC ENGINEERING GUIDANCE

If any hand exposure scenario in this chapter reflects tasks in your plant or maintenance team, PSC Hand Safety India can provide application-specific engineering guidance. Bring the task, the component, the work method, and the site conditions — PSC will identify the most appropriate engineering interface for your specific application.

TO RECEIVE APPLICATION-SPECIFIC GUIDANCE, DESCRIBE:

1. The specific task or operation
2. The equipment type and component
3. The component weight and geometry
4. Whether the component is ferrous
5. The work method currently in use
6. The frequency of the task
7. The working environment and access constraints
8. Your plant name and location

ENGINEERING GUIDANCE

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ENGINEER THE HAND OUT OF THE HAZARD™

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A PSC Hand Safety Brand

Refractory Maintenance

This chapter identifies typical manual hand exposure scenarios encountered in this department of an integrated steel plant and highlights representative PSC and LoadGrab® application solutions commonly used for similar industrial tasks. Final product selection should always consider the specific task, component geometry, operating environment and site risk assessment.

1 DEPARTMENT OVERVIEW

Facilitator opening: Ask the audience how much a ladle brick weighs — and how many bricks a refractory crew installs per shift during a ladle reline. The answer to the first question is typically 4–8 kg per brick. The answer to the second is 200 to 400 bricks per shift, depending on the ladle size and lining configuration. That means each tradesperson's hands handle between 1,000 and 3,000 kg of refractory material per shift — gripping individual bricks by the face, carrying them from the pallet, and seating them against the previous course. There is no engineered carry point on a refractory brick. There has never been one. The exposure is structural, repeated, and cumulative — and that is what this chapter addresses.

Refractory maintenance in an integrated steel plant covers the lining, relining, and repair of all high-temperature vessels: blast furnace hearth and stack, steel melt shop converters and ladles, continuous casting tundishes and ladles, reheating furnace hearth and roof, and ancillary vessels such as torpedo cars, mixers, and slag pots. The work is performed by specialist refractory crews — often contractors — in confined, hot, dust-laden environments after vessels have been cooled but before they have reached ambient temperature. The combination of abrasive material, elevated temperature, confined access, and high-volume repetitive manual handling makes refractory maintenance one of the most consistently hand-intensive activities in the plant.

The hand exposure in this chapter falls into two distinct patterns. The first is the sustained manual handling of refractory bricks and castable material — a Lift and Carry interaction repeated hundreds of times per shift without a designed carry interface on the product. The second is the tool-based interaction — breaking out worn lining, seating bricks against tight courses, anchoring and rod-scarfing — where the hand is close to a chisel, hammer, or ram under impact conditions.

2 MAJOR REFRACTORY MAINTENANCE LOCATIONS

LADLE & TUNDISH LINING

Ladle relining — barrel brickwork, safety lining, and working lining — is one of the highest-volume refractory tasks in the steel plant. Workers carry bricks from pallets to the lining position inside the ladle shell and seat each brick by hand against the previous course. Tundish lining with castable material involves mixing, carrying, and applying material inside the confined tundish cavity.

BOF / EAF CONVERTER LINING

Converter lining repair during campaign and full lining replacement during shutdown involve large refractory blocks and shaped bricks handled in the confined converter interior. The converter is typically accessed via a working platform inside the vessel — with no natural lighting and refractory dust throughout.

BLAST FURNACE HEARTH & STACK

BF hearth relining during a full campaign shutdown involves carbon blocks of 40–150 kg each — beyond the manual handling range and requiring mechanical aids. Taphole repair, tuyere brick replacement, and stack lining repairs involve hand-applied refractory and castable work in the tuyere zone and around the taphole. → See also Ch.05 (Blast Furnace) for tuyere zone access context.

REHEATING FURNACE HEARTH & ROOF

Furnace hearth skid rail refractory and roof brick replacement are carried out during the reheating furnace planned campaign shutdowns. Roof brick replacement requires overhead working — bricks held in position while mortar or anchors set, with the full brick weight sustained by the worker's arms during seating. → See also Ch.09 (Reheating Furnaces).

TORPEDO CAR & SLAG POT LINING

Torpedo car and slag pot linings are repaired or replaced between campaigns. These are smaller vessels than ladles but are similarly confined. Spray castable and hand-applied materials are used alongside brick work. The vessel shape — narrow top opening, wide interior — constrains the working position of the refractory crew throughout the lining operation.

BURNER BLOCK & TAPHOLE REPAIR

Burner block replacement in reheating furnaces and taphole repair at the blast furnace involve hand-applied refractory mass, tamping guns, and mud guns that apply material under hydraulic pressure. Adjacent to the taphole, chiselling and breaking out of old refractory uses hammer-and-chisel work in an irregular, hot, confined space.

3 MANUAL TASKS & HAND EXPOSURE SCENARIOS

ZONE A — BRICK CARRYING, LINING INSTALLATION & BREAKOUT

• HIGH · EXPOSURE FREQUENCY

Refractory Brick Carry & Course Setting — Ladle & Vessel Lining

CRUSH / LACERATION / STRAIN · LIFT / CONTROL

WHY THE HAND IS THERE

Refractory bricks have no designed carry point. They are gripped by the face — a smooth, abrasive surface — and carried from the pallet to the lining position inside the vessel. Each brick weighs 4–8 kg. A ladle reline involves 500–1500 bricks per ladle depending on size. The hand grips across the brick face on every carry, and the seating action — pressing the brick against the previous course while the mortar sets — places the hand in the space between the incoming brick face and the brick already in place. If the brick slips during seating, the catching hand is between the two brick faces.

HAND INTERFACE

Brick face and edge during grip-and-carry; mortar-coated brick face during seating against previous course; spring steel brick tong handle during tong-assisted carry

EXPOSURE TYPE

Cumulative hand and wrist strain from 200–400 brick lifts per shift with no designed grip surface; laceration from brick edge or arris; crush between incoming brick and seated course if brick slips during seating

LIFT **CONTROL** "During ladle brick lining, what is the method for carrying each brick from the pallet to the seating position — and what keeps the carrying hand clear of the pinch zone between the incoming brick and the seated course at the moment of seating?"

ENGINEERING INTERFACE CONSIDERATION

Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.

• HIGH · EXPOSURE FREQUENCY

Lining Breakout — Hammer, Chisel & Scabbling

IMPACT / LACERATION · CONTROL

WHY THE HAND IS THERE

Before a new lining is installed, the worn lining must be broken out — typically with hand hammers, chisels, electric scabblers, or pneumatic breakers. Hand chisel and hammer work in the vessel interior involves the holding hand steadying the chisel against the brick or castable surface during every blow. The surface is irregular, the working position is confined, and the chisel may deflect unpredictably off hard clinker or skull deposits. This is the refractory equivalent of the bearing race driving scenario — the holding hand is in the impact zone on every strike.

HAND INTERFACE

Chisel body during holding while hammer strikes; brick or castable surface being broken; hammer handle during swing; breaker body during scabbling

EXPOSURE TYPE

Hand struck by hammer if chisel slips off clinker surface; laceration from brick fragment or spall during breakout; hand struck by chisel rebound from hard deposit

CONTROL "During manual chisel breakout of worn ladle or furnace lining, is the chisel held by a tool — or gripped bare-handed — during hammer blows? And when the chisel deflects off a hard skull deposit, where does the hammer land?"

ENGINEERING INTERFACE CONSIDERATION

Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.

ZONE A — BRICK CARRYING, LINING INSTALLATION & BREAKOUT — CONTINUED

MEDIUM · EXPOSURE FREQUENCY

Refractory Anchor — Welding Preparation & Rod Fitting

PINCH / BURNS · CONTROL

WHY THE HAND IS THERE	HAND INTERFACE	EXPOSURE TYPE
In castable-lined vessels and furnaces, metallic anchors are welded to the shell before castable is applied. Anchor rods — typically Y or V-type, 6–10 mm wire — are positioned by hand against the shell and held while the welder tacks them in position. The anchor is held at the base against the shell while the weld is applied above — placing the holding hand at the arc flash boundary and in contact with a component that will become hot immediately after tacking.	Anchor rod body during positioning against shell; anchor base face against shell surface; anchor tip during rod-forming prior to installation	Burns from anchor body heating rapidly after tacking while held; arc flash exposure if hand is not shielded during tack; pinch between anchor base and shell if anchor is repositioned after first tack

CONTROL

"When a refractory anchor is held against the vessel shell while the welder tacks it, how far is the holding hand from the weld arc — and is there a tool or method that positions the anchor without the hand being at the tack zone?"

ENGINEERING INTERFACE CONSIDERATION

Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.

ZONE B — OVERHEAD LINING, HEAVY BLOCK HANDLING & VESSEL ACCESS		
• LOW · EXPOSURE FREQUENCY		
Furnace Roof — Overhead Brick Setting		BURNS / CRUSH · LIFT / CONTROL
WHY THE HAND IS THERE Reheating furnace roof brick replacement requires workers to hold bricks above their heads while positioning them against the roof arch structure. The brick must be held in place while the surrounding bricks are tapped into course alignment. This is a sustained overhead Load Control interaction — the full brick weight supported by the worker's hands throughout the positioning and tapping sequence. If a brick is released prematurely or slips from the mortar bed, the fall is directly onto the worker below. → See also Ch.09 (Reheating Furnaces).	HAND INTERFACE Brick face during overhead hold; adjacent brick edge during course alignment tap; roof arch surface during approach; mortar-coated brick face during seating	EXPOSURE TYPE Sustained strain on hands and wrists from overhead brick weight; burns from hot furnace roof structure; crush if adjacent brick is driven into the held brick during course alignment
CONTROL "During overhead furnace roof brick setting, how long is the brick held in position above the worker's head before the surrounding course is tapped into alignment — and what supports the brick during that interval?"		
ENGINEERING INTERFACE CONSIDERATION Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.		
• LOW · EXPOSURE FREQUENCY		
BF Hearth & Taphole — Carbon Block & Refractory Mass Handling		CRUSH / BURNS · LIFT
WHY THE HAND IS THERE Carbon blocks in the BF hearth weigh 40–150 kg each and require mechanical assistance for primary handling. Workers guide blocks during crane positioning and pack refractory mass around and between blocks by hand. Taphole repair involves hand-applied refractory mass — a dense, abrasive compound — packed into the taphole channel using tamping tools. The mass is applied directly by gloved hand or tamped with a rod, placing the hand close to the taphole opening where residual heat and skull deposits create a burn and laceration hazard. → See Ch.05 (Blast Furnace) for taphole zone access context.	HAND INTERFACE Carbon block body during crane guidance; refractory mass during hand packing; tamping rod during application; taphole edge proximity during packing	EXPOSURE TYPE Crush between carbon block and hearth structure during crane-guided block placement; burns from taphole residual heat during mass packing; laceration from skull deposit edges during tamping access
GUIDE "During BF taphole repair, how far does the worker's hand enter the taphole channel during refractory mass packing — and is there a tamping tool that positions the mass without the hand approaching the taphole opening?"		
ENGINEERING INTERFACE CONSIDERATION Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.		

ZONE B — OVERHEAD LINING, HEAVY BLOCK HANDLING & VESSEL ACCESS — CONTINUED		
• MEDIUM • EXPOSURE FREQUENCY		
Castable Mixing & Application — Confined Vessel Access		BURNS / CHEMICAL CONTACT · LIFT / CONTROL
WHY THE HAND IS THERE Castable refractory — a dense, abrasive, alkaline wet material — is mixed and applied by hand or pneumatic gunning in ladles, tundishes, torpedo cars, and furnace sections. Hand application involves pressing and smoothing the wet castable against the vessel shell — a sustained manual contact with a heavy, abrasive, chemically active material. Carrying mixed castable in buckets or shovelling from the mix point to the application point inside the vessel generates direct hand-to-castable contact throughout the application sequence.	HAND INTERFACE Wet castable surface during hand application; bucket or shovel handle during castable carry; vessel shell surface during application smoothing	EXPOSURE TYPE Chemical contact from alkaline castable on skin over extended application periods; burns if vessel shell is not adequately cooled before castable application begins; strain from sustained bucket carry and shovel work in confined vessel
CONTROL <i>"During castable application inside a ladle or tundish, how long is the crew in direct hand contact with the wet material — and is that contact duration tracked against the vessel's measured shell temperature at the time of application?"</i>		
ENGINEERING INTERFACE CONSIDERATION Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.		

4 CAMPAIGN SHUTDOWN — ADDITIONAL EXPOSURE

LOW frequency refers to how often the hand is exposed in normal operations. Campaign relining shutdowns concentrate refractory hand exposure into intensive multi-shift windows — cumulative hand and wrist loading across a ladle relining campaign is among the highest sustained manual handling exposures in the plant.

TASK	HAND EXPOSURE	FREQ.	EXPOSURE	PSC ENGINEERING INTERFACE PORTFOLIO
Full ladle reline — 500–1500 bricks	All bricks carried by hand from pallet to lining position; cumulative hand exposure across 2–3 shifts; no designed carry interface on individual bricks	LOW	CRUSH / STRAIN	PSC Manual Lifting Interfaces · PSC Striking & Alignment Interfaces
Converter lining — large shaped blocks	Large converter bricks and shaped blocks handled inside converter shell; working platform inside vessel; crane-assisted large block positioning with hand guidance at block face	LOW	CRUSH / BURNS	PSC Load Control Interfaces · PSC Position & Reach Interfaces · PSC Striking & Alignment Interfaces
Tundish spray lining & drying	Spray castable application in the tundish interior; hand smoothing of spray-applied material in confined tundish cavity; drying sequence with gas burner inside vessel	MED	BURNS / CHEMICAL	PSC Manual Lifting Interfaces · PSC Position & Reach Interfaces
Torpedo car lining — confined entry	Workers enter narrow torpedo car opening for brick and castable lining; highly confined working posture; brick carry through top opening into cylindrical vessel interior	LOW	CRUSH / BURNS	PSC Manual Lifting Interfaces · PSC Striking & Alignment Interfaces

5 CONTRACTOR REFRACTORY CREW INTERFACES

ACTIVITY	HAND EXPOSURE SCENARIO	EXPOSURE	PSC ENGINEERING INTERFACE PORTFOLIO
Specialist refractory contractor — bricklaying crew	High-volume brick carry and lining in ladles, converters, and vessels; crew may be unfamiliar with plant-standard tool deployment; highest-frequency hand exposure group in this chapter	CRUSH / STRAIN	PSC Manual Lifting Interfaces · PSC Striking & Alignment Interfaces
Demolition / breakout contractor	Manual and pneumatic lining breakout in all vessels; chisel and hammer work throughout; highest impact-hand-exposure window in refractory maintenance	IMPACT LACERATION	PSC Striking & Alignment Interfaces
Crane assistance — carbon block & converter block	Heavy refractory block crane operations at BF hearth and converter; workers guide blocks during crane positioning in confined vessel or hearth access	CRUSH	PSC Load Control Interfaces · PSC Position & Reach Interfaces

6 REFRACTORY MAINTENANCE QUICK ASSESSMENT CHECKLIST

Use during a refractory crew induction, campaign shutdown planning, or task risk assessment. Answer based on current observed practice.

- ☐ During ladle brick lining, is each brick carried from the pallet to the lining position with a designed carry interface — or gripped bare-handed by the brick face?
- ☐ During brick seating against the previous course, is the positioning hand clear of the pinch zone between the incoming brick and the seated brick at the moment of seating?
- ☐ During manual chisel breakout of worn lining, is the chisel held by a FingerSaver® or Chisel Holder — rather than gripped bare-handed — during every hammer blow?
- ☐ During refractory anchor welding, is the anchor positioned and held by a tool — or does the worker's hand contact the anchor body in the weld arc zone during tacking?
- ☐ During overhead furnace roof brick setting, how long is each brick held above the worker's head before the surrounding course is tapped in — and is that duration specified in the task procedure?
- ☐ During taphole repair, does the worker's hand enter the taphole channel during refractory mass packing — or is the mass applied through a tamping tool that keeps the hand clear of the opening?
- ☐ During castable application, is the total duration of direct hand-to-castable contact tracked — and is that duration assessed against the alkaline exposure limit for the material in use?
- ☐ For converter and BF carbon block crane operations, are anti-tangle taglines used throughout the full crane approach and vessel-entry sequence?
- ☐ Does the refractory contractor crew receive PSC hands-free tool induction at the site gate — or only production department inductions covering process hazards?

If you answered **Yes** to any of the above, PSC can review those tasks and recommend representative hands-free engineered interfaces to consider. Contact Shivani at **+91-96031-66448** or **sales@pschandsafety.com**

7 PSC ENGINEERING INTERFACE PORTFOLIO — REFRACTORY MAINTENANCE

The following PSC engineering interfaces are relevant to the hand exposure scenarios identified in this chapter. This table introduces PSC product families and their primary engineering functions. It does not map any product to a specific scenario or application.

PSC LOAD CONTROL INTERFACES		
PSC ENGINEERING INTERFACE	PRIMARY FUNCTION	REPRESENTATIVE PART NUMBERS
PSC LoadGuider® Anti-Tangle Tagline	Controls suspended loads from a safe distance during crane operations	PSC-LGTC-15 PSC-LGTC-20 PSC-LGTC-25 PSC-LGTC-30
PSC Guidelt® Safety Rigger Tagline	Provides a safe, reusable tagline interface for controlling suspended loads from a stand-off distance throughout the lifting operation	PSC-GISRT-10 PSC-GISRT-15
PSC RiggerMate® Hook	Positions slings, shackles and rigging components without direct hand contact on rigging	PSC-RMH
PSC TaglineRetriever	Retrieves tagline rope ends after load landing without the operator entering the load zone	PSC-TRT PSC-TRT-3P
PSC POSITION & REACH INTERFACES		
PSC ENGINEERING INTERFACE	PRIMARY FUNCTION	REPRESENTATIVE PART NUMBERS
PSC LoadGuider® Push/Pull Pole	Pushes and pulls loads, components and rigging at a safe standoff distance	PSC-LG-42 PSC-LG-50 PSC-LG-72 PSC-LG-96
PSC Guide-It® Push/Pull Pole	Heavy-duty extended-reach push/pull for higher-force load guidance and positioning	PSC-GIT-50 PSC-GIT-72 PSC-GIT-96
PSC Load-It® Push/Pull Tool	Positions, guides and controls components using interchangeable heads suited to specific load geometries	PSC-LIT-S004 PSC-LIT-S006 PSC-LIT-S008
PSC SafeGuider Tool	Provides controlled standoff access to confined, hot or hazardous locations during maintenance	PSC-STGT-36 PSC-STGT-48
PSC MANUAL LIFTING INTERFACES		
PSC ENGINEERING INTERFACE	PRIMARY FUNCTION	REPRESENTATIVE PART NUMBERS
PSC Lift Assist Sling — Single Handle	Provides an engineered carry interface for components without a designed grip point, within manual handling limits	HSF-SH-075
PSC Lift Assist Sling — Double Handle	Provides a two-person engineered carry interface for longer components, within manual handling limits	HSF-DH-100
PSC Lift Assist Sling — Valve & Motor	Provides an engineered carry interface for valves, small motors and small pump bodies	HSF-CV
PSC Handle-Tech Pipe Lifter	Provides an engineered grip interface for pipe and hose carry without barrel gripping or finger-beneath-pipe contact	PSC-HTL-002 PSC-HTL-004 PSC-HTL-006
PSC EzyLift Pipe Lifting Tool	Provides a wrist-neutral lift interface for pipe and bar sections from floor or rack surfaces	PSC-EZYLFT
PSC STRIKING & ALIGNMENT INTERFACES		
PSC ENGINEERING INTERFACE	PRIMARY FUNCTION	REPRESENTATIVE PART NUMBERS
PSC FingerSaver®	Holds slogging spanners, drifts, chisels and punches during hammer striking, keeping the holding hand outside the impact zone	PSC-FS-295 PSC-FS-375 PSC-FS-850
PSC Chisel & Punch Holder	Holds narrow chisels and punches during light hammer striking where a smaller holding interface is required	PSC-CPH

Selection of the appropriate engineering interface depends on the specific application, load characteristics, work method and site conditions. **Contact PSC Hand Safety India for application-specific engineering guidance and product recommendations.**

— APPLICATION-SPECIFIC ENGINEERING GUIDANCE

If any hand exposure scenario in this chapter reflects tasks in your plant or maintenance team, PSC Hand Safety India can provide application-specific engineering guidance. Bring the task, the component, the work method, and the site conditions — PSC will identify the most appropriate engineering interface for your specific application.

TO RECEIVE APPLICATION-SPECIFIC GUIDANCE, DESCRIBE:

1. The specific task or operation
2. The equipment type and component
3. The component weight and geometry
4. Whether the component is ferrous
5. The work method currently in use
6. The frequency of the task
7. The working environment and access constraints
8. Your plant name and location

ENGINEERING GUIDANCE

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CHAPTER 20 OF 22

Electrical & Instrumentation Maintenance

This chapter identifies typical manual hand exposure scenarios encountered in this department of an integrated steel plant and highlights representative PSC and LoadGrab® application solutions commonly used for similar industrial tasks. Final product selection should always consider the specific task, component geometry, operating environment and site risk assessment.

1 DEPARTMENT OVERVIEW

Facilitator opening: Ask the audience what the standard process is for replacing a motor in their plant — and specifically who carries the motor from the lay-down area to the base plate. In most plants the answer is the E&I or electrical maintenance crew. Then ask whether those electricians carry the motor the same way the mechanical crew does — gripping the cooling fins. In most plants, the answer is yes. The motor's weight does not change because it is being moved by an electrician rather than a fitter. But the tool provision often does. The E&I team's hand exposure is not primarily electrical — it is the same manual handling, component positioning, and confined-space access exposure as the mechanical team, in addition to the specific risks of cable pulling, instrument removal, and working in energised panels.

The Electrical and Instrumentation Maintenance team services every motor, drive, control panel, instrumentation loop, and field device across the integrated plant. Their work spans from large motor replacement to replacement of a thermocouple in a reheating furnace roof. The physical hand exposure in E&I maintenance falls into three categories: manual handling of electrical components (motors, transformers, cable drums, switchgear); instrument and sensor replacement in confined or elevated locations (thermocouples, encoders, limit switches); and cable installation work (pulling, routing, terminating). This chapter addresses the non-electrical hand exposure in E&I maintenance — the mechanical handling and physical interaction component that is not always included in electrical safety assessments.

2 MAJOR E&I MAINTENANCE ACTIVITIES

MOTOR REPLACEMENT — ALL FRAMES

Small frame motors are carried and handled manually; medium and large frame motors require crane assistance. The motor replacement task — extraction, carry, and reinstallation with coupling alignment — produces the same hand exposure as the mechanical maintenance motor replacement in Ch.18. This chapter adds the context that E&I teams perform this task frequently across all departments.

CABLE PULLING & TRAY INSTALLATION

Heavy power cables are pulled from drum to termination point through cable trays, conduits, and cable routes. Cables may weigh several kilograms per metre. Cable pulling generates sustained grip and wrist loading — and rope-and-pulling-grip hand exposure at the head of the pull. Cable tray installation involves handling structural steel sections above head height.

INSTRUMENT REPLACEMENT — FIELD DEVICES

Thermocouples, RTDs, encoders, proximity sensors, limit switches, and solenoid valves are replaced in confined, elevated, and thermally challenging locations throughout the plant. Access to the instrument location often requires reaching into confined spaces — near rotating equipment, inside furnace walls, or inside energised panels — where the hand position is constrained by the access geometry.

MCC & CONTROL PANEL WORK

SWITCHGEAR MAINTENANCE

MCC drawers, contactors, and switchgear components are removed and replaced during planned maintenance. Drawer extraction from MCC cubicles, heavy contactor handling, and bus bar work involve direct hand contact with heavy electrical components in confined panel access positions.

TRANSFORMER & DRIVE MAINTENANCE

Small transformers and drive units are removed from panels or substation racks for replacement or repair. These components may weigh 20–80 kg and are handled manually or with crane assistance. During installation, the component must be lifted into the rack and held in position while mounting bolts are started.

GAS CYLINDER HANDLING — CALIBRATION & PURGE GAS

Calibration gas cylinders for analyser systems and purge gas cylinders for instrument enclosures are repositioned across the plant by E&I technicians. These cylinders are handled without a designed grip and are subject to tip-over and valve damage risk during movement. → PSC GasGrab® is the specific interface for this task, as in Ch.18.

3 MANUAL TASKS & HAND EXPOSURE SCENARIOS

ZONE A — MOTOR HANDLING · CABLE PULLING · INSTRUMENT ACCESS

• HIGH · EXPOSURE FREQUENCY

Motor Carry & Base-plate Installation — All Frame Sizes

CRUSH / LACERATION · LIFT / CONTROL

WHY THE HAND IS THERE	HAND INTERFACE	EXPOSURE TYPE
Small frame motors are carried by E&I technicians from the electrical workshop or stores to the installation point and lifted onto the base plate. The motor body has no designed carry point — the cooling fins are the instinctive grip, but they are thin, sharp-edged projections designed for heat dissipation, not lifting. During installation, the motor must be held in position on the base plate while mounting bolts are started — placing hands between the motor frame and the base plate structure. → See Ch.18 (Mechanical Maintenance), Shutdown Table — Motor Removal & Reinstallation for full interaction detail.	Motor cooling fin or casing body during carry; motor frame face during base-plate alignment; mounting bolt zone during first stud engagement	Laceration from cooling fin edge during carry; hand crushed between motor frame and base plate if motor drops into alignment position; pinch at mounting bolt zone during first bolt engagement
LIFT CONTROL "When an electrician carries a replacement motor from stores to the installation point, what is the grip — and is it the same grip that a fitter would use, with the same risk of laceration from the cooling fin edges?"		
ENGINEERING INTERFACE CONSIDERATION Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.		

• HIGH · EXPOSURE FREQUENCY

Cable Pulling — Heavy Power Cable from Drum to Termination

STRAIN / CAUGHT-BETWEEN · LIFT / CONTROL

WHY THE HAND IS THERE	HAND INTERFACE	EXPOSURE TYPE
Heavy power cable is pulled through cable trays, conduit, and cable routes from the drum point to the termination panel. The cable head is pulled by rope or directly by hand at the lead end. At direction changes and through cable cleats or tray dividers, workers reach into the tray to guide the cable head through the restricted passage — with the cable under tension from the pulling crew behind them. If the cable releases under tension suddenly, the recoil can involve the guiding hand.	Cable head during direct-pull guidance; cable body during routing through tray cleats; rope or grip tool at cable head during pulling; cable tray edge during reach-in guidance	Hand caught between cable and cable tray edge during tight-radius guidance; rope burn or grip injury at pull head during heavy cable pull; hand in line of fire of cable recoil if pull rope releases under tension
CONTROL "During heavy cable pulling, when the cable head is guided through a tray bend or cleat by hand, is the guiding hand between the cable and the tray structure — and what happens to that hand if the cable releases from the pull tension suddenly?"		
ENGINEERING INTERFACE CONSIDERATION Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.		

ZONE A — MOTOR HANDLING · CABLE PULLING · INSTRUMENT ACCESS — CONTINUED

• HIGH · EXPOSURE FREQUENCY

Thermocouple & RTD Replacement — Confined & Elevated Access

BURNS / PINCH · CONTROL

WHY THE HAND IS THERE	HAND INTERFACE	EXPOSURE TYPE
Thermocouples and RTDs in furnace roofs, vessel walls, and process equipment require replacement when they fail. Access to the instrument pocket is typically through a small opening in the furnace or vessel shell — confined, often elevated, and at residual elevated temperature. The instrument is extracted by unscrewing the connection head and withdrawing the thermowell by hand. The thermowell may retain heat from the process, and the surrounding structure constrains the hand position during extraction and reinsertion. → See also Ch.09 (Reheating Furnaces) for furnace-specific thermocouple replacement context.	Thermowell body during extraction and reinsertion; connection head nut; instrument pocket opening edge; surrounding shell structure during confined access	Burns from hot thermowell body; pinch between thermowell and pocket opening edge during extraction; hand in line of fire if thermowell releases suddenly from a corroded seating

RETRIEVE

"During thermocouple replacement in a reheating furnace or vessel wall, how is the thermowell temperature confirmed before the hand contacts the thermowell body during extraction?"

ENGINEERING INTERFACE CONSIDERATION

Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.

ZONE B — MCC DRAWERS · SWITCHGEAR · CALIBRATION GAS

• MEDIUM · EXPOSURE FREQUENCY

MCC Drawer & Contactor —
Extraction & Replacement

CRUSH / PINCH · RETRIEVE / LIFT

WHY THE HAND IS THERE

MCC drawers and contactors are extracted from their cubicles during planned maintenance and fault replacement. Drawers have no external grip surface other than the door handle or the drawer body itself. Heavy contactors inside the drawer are gripped by the coil body or the terminal block, which are not designed carry surfaces. During reinsertion, the drawer must be aligned with the cubicle rail and pushed into the bus bar connection — with both hands on the drawer body in close proximity to the open rear of the cubicle.

HAND INTERFACE

Drawer body or handle face during extraction; contactor body during carry; drawer guide rail during alignment for reinsertion; bus bar zone during final push engagement

EXPOSURE TYPE

Hand crushed between drawer and cubicle frame during extraction or reinsertion; pinch at cubicle guide rail during alignment; hand in proximity to open bus bar zone if drawer is not fully isolated before extraction

RETRIEVE

"During MCC drawer extraction, is the drawer in an isolated and withdrawn state before the hands contact the drawer body — and is the bus bar positively isolated against energisation while the drawer is out of the cubicle?"

ENGINEERING INTERFACE CONSIDERATION

Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.

• HIGH · EXPOSURE FREQUENCY

Calibration & Purge Gas Cylinder —
Repositioning

CRUSH / STRUCK-BY · LIFT

WHY THE HAND IS THERE

E&I technicians reposition calibration gas cylinders for analyser systems and purge gas cylinders for instrument enclosures throughout the plant. Cylinders have no designed carry grip — they are tall, narrow, and top-heavy, with the valve protruding from the crown. Manual repositioning by tilting and rolling exposes the valve to damage and risks tip-over onto the handling hand. This is a direct PSC GasGrab® application. → See Ch.18 (Mechanical Maintenance) Shutdown Table for the same task in the maintenance context.

HAND INTERFACE

Cylinder body during tilt-and-roll; cylinder valve housing during grip-and-carry; floor surface when cylinder is set down during repositioning

EXPOSURE TYPE

Hand crushed under cylinder if it tips during repositioning; valve damage and gas release if valve strikes floor or adjacent equipment; hand struck by cylinder during tip-and-roll movement

CONTROL

"When a calibration gas cylinder is moved to a new analyser station, is it tilted and rolled on its base edge — and if it tips during that movement, where does the cylinder valve and body land relative to the handler's hands?"

ENGINEERING INTERFACE CONSIDERATION

Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.

4 SHUTDOWN & CONTRACTOR — ADDITIONAL EXPOSURE

TASK	HAND EXPOSURE	FREQ.	EXPOSURE	PSC ENGINEERING INTERFACE CATEGORY
Large motor replacement by crane	Medium and large motors crane-guided onto base plate; same coupling alignment exposure as mechanical crew with same Control interaction at motor frame	LOW	CRUSH	PSC Load Control Interfaces · PSC Manual Lifting Interfaces
Cable tray installation — overhead	Steel cable tray sections handled above head height; tray sections lifted, aligned, and held during bolt-up; hand between tray and structure during alignment	MED	CRUSH / PINCH	PSC Manual Lifting Interfaces · PSC Striking & Alignment Interfaces
Encoder & proximity sensor replacement near rotating equipment	Sensors replaced in confined locations adjacent to drive shafts and rotating elements; hand access into sensor mounting zone near rotating equipment that may not be fully isolated	MED	CAUGHT-BETWEEN	PSC Position & Reach Interfaces · PSC Striking & Alignment Interfaces

7 PSC ENGINEERING INTERFACE PORTFOLIO — ELECTRICAL & INSTRUMENTATION MAINTENANCE

The following PSC engineering interfaces are relevant to the hand exposure scenarios identified in this chapter. This table introduces PSC product families and their primary engineering functions. It does not map any product to a specific scenario or application.

PSC LOAD CONTROL INTERFACES		
PSC ENGINEERING INTERFACE	PRIMARY FUNCTION	REPRESENTATIVE PART NUMBERS
PSC LoadGuider® Anti-Tangle Tagline	Controls suspended loads from a safe distance during crane operations	PSC-LGTC-15 PSC-LGTC-20 PSC-LGTC-25 PSC-LGTC-30
PSC Guidelt® Safety Rigger Tagline	Provides a safe, reusable tagline interface for controlling suspended loads from a stand-off distance throughout the lifting operation	PSC-GISRT-10 PSC-GISRT-15
PSC RiggerMate® Hook	Positions slings, shackles and rigging components without direct hand contact on rigging	PSC-RMH
PSC TaglineRetriever	Retrieves tagline rope ends after load landing without the operator entering the load zone	PSC-TRT PSC-TRT-3P
PSC POSITION & REACH INTERFACES		
PSC ENGINEERING INTERFACE	PRIMARY FUNCTION	REPRESENTATIVE PART NUMBERS
PSC LoadGuider® Push/Pull Pole	Pushes and pulls loads, components and rigging at a safe standoff distance	PSC-LG-42 PSC-LG-50 PSC-LG-72 PSC-LG-96
PSC Guide-It® Push/Pull Pole	Heavy-duty extended-reach push/pull for higher-force load guidance and positioning	PSC-GIT-50 PSC-GIT-72 PSC-GIT-96
PSC Load-It® Push/Pull Tool	Positions, guides and controls components using interchangeable heads suited to specific load geometries	PSC-LIT-S004 PSC-LIT-S006 PSC-LIT-S008
PSC SafeGuider Tool	Provides controlled standoff access to confined, hot or hazardous locations during maintenance	PSC-STGT-36 PSC-STGT-48
PSC MANUAL LIFTING INTERFACES		
PSC ENGINEERING INTERFACE	PRIMARY FUNCTION	REPRESENTATIVE PART NUMBERS
PSC Lift Assist Sling — Single Handle	Provides an engineered carry interface for components without a designed grip point, within manual handling limits	HSF-SH-075
PSC Lift Assist Sling — Double Handle	Provides a two-person engineered carry interface for longer components, within manual handling limits	HSF-DH-100
PSC Lift Assist Sling — Valve & Motor	Provides an engineered carry interface for valves, small motors and small pump bodies	HSF-CV
PSC Handle-Tech Pipe Lifter	Provides an engineered grip interface for pipe and hose carry without barrel gripping or finger-beneath-pipe contact	PSC-HTL-002 PSC-HTL-004 PSC-HTL-006
PSC EzyLift Pipe Lifting Tool	Provides a wrist-neutral lift interface for pipe and bar sections from floor or rack surfaces	PSC-EZYLFT

PSC Engineering Interface Portfolio — continued

PSC STRIKING & ALIGNMENT INTERFACES		
PSC ENGINEERING INTERFACE	PRIMARY FUNCTION	REPRESENTATIVE PART NUMBERS
PSC FingerSaver®	Holds slogging spanners, drifts, chisels and punches during hammer striking, keeping the holding hand outside the impact zone	PSC-FS-295 PSC-FS-375 PSC-FS-850
PSC Chisel & Punch Holder	Holds narrow chisels and punches during light hammer striking where a smaller holding interface is required	PSC-CPH
PSC SPECIALISED MAINTENANCE INTERFACES		
PSC ENGINEERING INTERFACE	PRIMARY FUNCTION	REPRESENTATIVE PART NUMBERS
PSC GasGrab® Cylinder Mover	Moves gas cylinders without tilt-and-roll, protecting the valve and removing the hand from the cylinder body	PSC-GG-152 PSC-GG-230 PSC-GG-254
PSC Grapppler Hook Tool	Engages chains, hooks and lashing components without fingers in the hook or link zone	PSC-GRA001-28 PSC-GRA001-40
Selection of the appropriate engineering interface depends on the specific application, load characteristics, work method and site conditions. Contact PSC Hand Safety India for application-specific engineering guidance and product recommendations.		

— APPLICATION-SPECIFIC ENGINEERING GUIDANCE

If any hand exposure scenario in this chapter reflects tasks in your plant or maintenance team, PSC Hand Safety India can provide application-specific engineering guidance. Bring the task, the component, the work method, and the site conditions — PSC will identify the most appropriate engineering interface for your specific application.

TO RECEIVE APPLICATION-SPECIFIC GUIDANCE, DESCRIBE:

1. The specific task or operation
2. The equipment type and component
3. The component weight and geometry
4. Whether the component is ferrous
5. The work method currently in use
6. The frequency of the task
7. The working environment and access constraints
8. Your plant name and location

ENGINEERING GUIDANCE

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CHAPTER 21 OF 22

Utilities & Services

This chapter identifies typical manual hand exposure scenarios encountered in this department of an integrated steel plant and highlights representative PSC and LoadGrab® application solutions commonly used for similar industrial tasks. Final product selection should always consider the specific task, component geometry, operating environment and site risk assessment.

1 DEPARTMENT OVERVIEW

Facilitator opening: Ask the audience which department in their plant runs 24 hours a day, 365 days a year, with no planned shutdown, no campaign pause, and no process break — and whose maintenance team therefore has no scheduled maintenance window and must work on live or near-live systems throughout. In most plants, the answer is Utilities: the power generation, water treatment, compressed air, gas distribution, and effluent systems that serve every other department without interruption. The utilities maintenance team works on the most continuous systems in the plant, under the most variable isolation conditions, with the least overlap with the production shutdown schedule.

Utilities and Services in an integrated steel plant provides the continuous infrastructure that every other department depends on: power generation and distribution, cooling water systems, compressed air networks, gas distribution (coke oven gas, blast furnace gas, natural gas, oxygen, nitrogen, argon), steam generation and distribution, water treatment and effluent handling, and fire protection systems. The department covers a large physical area — from power generation buildings at one end of the site to gas holder structures, water towers, and effluent ponds at the other. The maintenance team travels continuously across the plant boundary to service all of these systems.

The hand exposure in Utilities maintenance differs from process department maintenance in one key respect: the systems are live — at pressure, at temperature, or energised — for a large proportion of the maintenance interaction. Zero-energy state is the requirement, but confirming that state across complex interconnected systems is a technical challenge that is not always met before hands enter the work zone. This chapter addresses the hand exposure scenarios that arise from this characteristic — and the interfaces that keep hands outside the work zone during the confirmation sequence.

2 MAJOR UTILITIES MAINTENANCE ACTIVITIES

WATER PUMP & PIPELINE MAINTENANCE

Cooling water, fire water, and process water pump maintenance; pipeline valve isolation, spool replacement, and flange connection work. Pumps and valves are in continuous service — maintenance windows require partial system isolation while adjacent circuits remain live. → Pump and valve handling cross-referenced in Ch.18.

GAS DISTRIBUTION — PIPELINES & HOLDERS

Coke oven gas, blast furnace gas, and natural gas distribution systems require periodic valve, flanges, and spool maintenance. Gas pipe spool and valve work requires multiple isolation points — purge, blind, and vent — before hand access. Adjacent to live gas systems, the hand exposure from flange bolt-up and spool carry mirrors the pipe handling scenarios in Ch.18.

STEAM BOILER & DISTRIBUTION

Steam boiler tube inspection and replacement during planned outages; steam distribution valve and flange work. Steam system maintenance has the highest residual-energy risk in the utilities department — steam at pressure and temperature remains hazardous long after isolation, and confirmation of zero pressure requires physical check at the work point. → See line-of-fire pattern, Ch.10 (hydraulic), Ch.15 (coolant). Steam is the highest-energy version of this scenario.

COMPRESSED AIR — COMPRESSOR & DISTRIBUTION

Air compressor maintenance, air receiver inspection, and compressed air line repair. Residual compressed air pressure in receivers and distribution lines is a line-of-fire hazard during fitting work if isolation does not include physical venting. Compressor valve plates and piston ring replacement require confined access to cylinder heads.

COOLING TOWER & WATER TREATMENT

Cooling tower fill pack replacement, basin cleaning, and distribution nozzle maintenance. Water treatment chemical dosing pump maintenance and filter backwash system maintenance. The cooling tower environment — wet, elevated, slippery — adds a secondary hand exposure risk (fall-arrest grip failure) to the primary maintenance contact risks.

OXYGEN, NITROGEN & ARGON SYSTEMS

Cryogenic and pressurised gas pipelines for steelmaking process gases require valve, flange, and instrument maintenance in a specialist environment. Physical flange and valve work follows the same spool-handling and flange bolt-up pattern as gas distribution — with the additional context of oxygen enrichment hazard in any oxygen system. → PSC GasGrab® for cylinder handling throughout.

3

MANUAL TASKS & HAND EXPOSURE SCENARIOS

ZONE A — PRESSURISED SYSTEMS: VALVES, FLANGES & PIPE SPOOLS

• HIGH · EXPOSURE FREQUENCY

Pipeline Valve & Spool — Isolation, Removal & Reinstallation

LINE-OF-FIRE / CRUSH · CONTROL

WHY THE HAND IS THERE	HAND INTERFACE	EXPOSURE TYPE
Utilities pipeline valves and pipe spools are removed for maintenance in an environment where adjacent lines remain live at pressure, elevated temperature, or carrying process gases. Flange bolt-up during reinstallation requires both hands in the space between the flange faces — the same pinch-zone exposure as the valve reinstallation in Ch.18 (Mechanical Maintenance), but with the additional hazard that a neighbouring unblinded branch may be at pressure when the flange bolts are started. → Cross-reference Ch.18 Scenario 4 for full flange alignment interaction detail.	Valve or spool body during carry; flange bolt-hole zone during alignment against mating flange; gasket face during seating; adjacent live flange in close proximity	Hand in line of fire of pressurised fluid if adjacent isolation is incomplete; hand crushed between flange faces if spool slips during bolt engagement; steam, water, or gas burn if system is at temperature or pressure during flange work

CONTROL

"During utilities pipeline flange bolt-up, what confirms that every adjacent branch on the working flange is isolated and physically blinded — not just the main line valve — before the first bolt is entered?"

ENGINEERING INTERFACE CONSIDERATION

Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.

• HIGH · EXPOSURE FREQUENCY

Compressed Air Receiver & Line — Pressure Confirmation & Fitting Work

LINE-OF-FIRE · CONTROL

WHY THE HAND IS THERE	HAND INTERFACE	EXPOSURE TYPE
Compressed air receiver inspection, drain valve replacement, and airline fitting work require access to pressurised system points. Compressed air at 7–10 bar retains its hazard for an extended period after isolation if the receiver is not physically vented — isolation alone is insufficient. Workers approach fitting connection points on the basis of valve closure confirmation, not physical zero-pressure confirmation. The fitting-breaking hand is in the line of fire of the residual pressure at every fitting unless venting is confirmed at the work point.	Air line fitting body during breaking; drain valve body during replacement; receiver inspection port during access; airline coupling during connection work	Hand and face in line of fire of compressed air release if fitting is broken without zero-pressure confirmation at the work point; pinch at fitting thread during connection with airline under tension

CONTROL

"During compressed air line fitting work, is zero pressure confirmed by venting at the work point itself — or confirmed only at the panel isolator? What is the pressure in the spur line between the isolator and the fitting at the moment the fitting is broken?"

ENGINEERING INTERFACE CONSIDERATION

Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.

ZONE B — COOLING TOWER · GAS CYLINDERS · STEAM

ZONE A — PRESSURISED SYSTEMS: VALVES, FLANGES & PIPE SPOOLS — CONTINUED		
• MEDIUM • EXPOSURE FREQUENCY		
Cooling Tower — Fill Pack & Distribution Nozzle Maintenance	CRUSH / LACERATION · RETRIEVE / LIFT	
WHY THE HAND IS THERE Cooling tower fill pack — the structured plastic media through which water falls — is removed for inspection and replacement in sections. Fill packs sit in frames above the basin; workers reach into the tower structure to lift sections clear. Fill pack edges are sharp PVC sections. Distribution nozzles above the fill pack require unscrewing and replacement — an overhead access task in a wet, slippery environment. The secondary hand exposure risk in this environment is grip failure from slippery tower surfaces; PSC interfaces reduce the grip demand during the primary maintenance contact.	HAND INTERFACE Fill pack body and edge during extraction from frame; distribution nozzle body during overhead replacement; tower basin edge during reach-in access	EXPOSURE TYPE Laceration from fill pack edge during extraction; crush if fill pack frame drops during section removal; hand in line of fire of water distribution nozzle if not isolated before nozzle is removed
RETRIEVE "During cooling tower fill pack extraction, what prevents the adjacent pack sections from sliding into the extraction gap and trapping the worker's hand in the frame while the target section is being lifted clear?"		
ENGINEERING INTERFACE CONSIDERATION Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.		

• HIGH · EXPOSURE FREQUENCY		
Industrial Gas Cylinder — Repositioning at Gas Stations		
CRUSH / STRUCK-BY · LIFT		
WHY THE HAND IS THERE	HAND INTERFACE	EXPOSURE TYPE
Oxygen, nitrogen, argon, and process gas cylinders are repositioned at gas stations and storage areas across the plant by utilities crew. The cylinder valve is unprotected during movement unless a valve cap is fitted. Tip-over during movement risks valve shear — a catastrophic gas release — and risks the cylinder body landing on the handling hand. → This is the same task as in Ch.18 and Ch.20; PSC GasGrab® is the consistent interface across all three chapters.	Cylinder body during tilt-and-roll movement; cylinder valve housing if grip is taken at valve area; floor surface when cylinder tips	Hand crushed under cylinder body if it tips during movement; valve damage and gas release if cylinder is tipped onto the valve; struck-by if cylinder rolls off a slope during movement
CONTROL "When oxygen or nitrogen cylinders are moved between gas stations, is the movement done with a purpose-designed cylinder mover — or by tilt-and-roll with hands on the cylinder body?"		
ENGINEERING INTERFACE CONSIDERATION		
Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.		

7 PSC ENGINEERING INTERFACE PORTFOLIO — UTILITIES & SERVICES

The following PSC engineering interfaces are relevant to the hand exposure scenarios identified in this chapter. This table introduces PSC product families and their primary engineering functions. It does not map any product to a specific scenario or application.

PSC POSITION & REACH INTERFACES		
PSC ENGINEERING INTERFACE	PRIMARY FUNCTION	REPRESENTATIVE PART NUMBERS
PSC LoadGuider® Push/Pull Pole	Pushes and pulls loads, components and rigging at a safe standoff distance	PSC-LG-42 PSC-LG-50 PSC-LG-72 PSC-LG-96
PSC Guide-It® Push/Pull Pole	Heavy-duty extended-reach push/pull for higher-force load guidance and positioning	PSC-GIT-50 PSC-GIT-72 PSC-GIT-96
PSC Load-It® Push/Pull Tool	Positions, guides and controls components using interchangeable heads suited to specific load geometries	PSC-LIT-S004 PSC-LIT-S006 PSC-LIT-S008
PSC SafeGuider Tool	Provides controlled standoff access to confined, hot or hazardous locations during maintenance	PSC-STGT-36 PSC-STGT-48
PSC MANUAL LIFTING INTERFACES		
PSC ENGINEERING INTERFACE	PRIMARY FUNCTION	REPRESENTATIVE PART NUMBERS
PSC Lift Assist Sling — Single Handle	Provides an engineered carry interface for components without a designed grip point, within manual handling limits	HSF-SH-075
PSC Lift Assist Sling — Double Handle	Provides a two-person engineered carry interface for longer components, within manual handling limits	HSF-DH-100
PSC Lift Assist Sling — Valve & Motor	Provides an engineered carry interface for valves, small motors and small pump bodies	HSF-CV
PSC Handle-Tech Pipe Lifter	Provides an engineered grip interface for pipe and hose carry without barrel gripping or finger-beneath-pipe contact	PSC-HTL-002 PSC-HTL-004 PSC-HTL-006
PSC EzyLift Pipe Lifting Tool	Provides a wrist-neutral lift interface for pipe and bar sections from floor or rack surfaces	PSC-EZYLFT
PSC STRIKING & ALIGNMENT INTERFACES		
PSC ENGINEERING INTERFACE	PRIMARY FUNCTION	REPRESENTATIVE PART NUMBERS
PSC FingerSaver®	Holds slogging spanners, drifts, chisels and punches during hammer striking, keeping the holding hand outside the impact zone	PSC-FS-295 PSC-FS-375 PSC-FS-850
PSC Chisel & Punch Holder	Holds narrow chisels and punches during light hammer striking where a smaller holding interface is required	PSC-CPH
PSC SPECIALISED MAINTENANCE INTERFACES		
PSC ENGINEERING INTERFACE	PRIMARY FUNCTION	REPRESENTATIVE PART NUMBERS
PSC GasGrab® Cylinder Mover	Moves gas cylinders without tilt-and-roll, protecting the valve and removing the hand from the cylinder body	PSC-GG-152 PSC-GG-230 PSC-GG-254
PSC Grapppler Hook Tool	Engages chains, hooks and lashing components without fingers in the hook or link zone	PSC-GRA001-28 PSC-GRA001-40

Selection of the appropriate engineering interface depends on the specific application, load characteristics, work method and site conditions. **Contact PSC Hand Safety India for application-specific engineering guidance and product recommendations.**

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1. The specific task or operation
2. The equipment type and component
3. The component weight and geometry
4. Whether the component is ferrous
5. The work method currently in use
6. The frequency of the task
7. The working environment and access constraints
8. Your plant name and location

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CHAPTER 22 OF 22

Material Handling, Logistics & Despatch

This chapter identifies typical manual hand exposure scenarios encountered in this department of an integrated steel plant and highlights representative PSC and LoadGrab® application solutions commonly used for similar industrial tasks. Final product selection should always consider the specific task, component geometry, operating environment and site risk assessment.

1 DEPARTMENT OVERVIEW

Facilitator opening: Every earlier chapter in this manual described hand exposure at the point of production or maintenance — inside a furnace, at a mill stand, on a maintenance base plate. This chapter describes what happens after production is complete. The finished product — coils, plates, billets, rail lengths, bundles of bar — must be loaded onto a wagon, a truck, or a ship's hold. Ask the audience: when a coil is being loaded onto a flatbed wagon by crane, and the sling is being removed from the coil eye after landing, where are the rigger's hands relative to the coil body and the wagon deck? In most plants, the answer is: directly between the coil and the deck, removing the sling by hand while the crane holds the coil centimetres above the final seating position. That moment — the last 300 mm of the load's travel — is what this chapter addresses.

The Material Handling, Logistics, and Despatch function receives finished product from every rolling mill, finishing bay, and warehouse in the plant and loads it for outward despatch by rail, road, or ship. The function also manages internal product movement between departments — coil transfer from the hot strip mill to the cold rolling mill, plate transfer from the plate mill to the cut-to-length line, billet transfer from the SMS to the bar mill. The department operates the plant's overhead cranes, forklift fleet, wagon loading equipment, and truck loading bays as primary tools.

The hand exposure in this department is concentrated at two points: the last phase of every crane lift, where the load is guided onto its transport surface and the sling or tagline must be disengaged; and the manual interface with chains, slings, dunnage, and lashing equipment used to secure loads for transport. Both are high-frequency, often compressed into timed windows (train departure, truck turnaround), and performed by workers whose primary training is in crane operation and logistics — not necessarily in hand safety engineering.

2 MAJOR DESPATCH & LOGISTICS ACTIVITIES

COIL LOADING — WAGON & TRUCK

Hot rolled, cold rolled, and coated coils are loaded onto flat wagons and truck trailers by overhead crane. Each coil is lifted from the coil yard by C-hook, coil grab, or sling and lowered onto the transport surface. Sling disengagement, coil positioning, and dunnage placement all occur with the coil on or near the wagon deck — with the worker's hands at the coil body throughout.

PLATE & HEAVY SECTION LOADING

Steel plates and heavy structural sections are loaded by overhead crane or gantry crane onto wagons and trailers. Plates are lifted from the finishing bay or plate yard and lowered onto the transport surface. Section bundles are hoisted by multi-point sling and guided onto the wagon. At each lift, a rigger guides the load during the final approach and disengages the sling on landing.

BILLET & BLOOM WAGON LOADING

Billets and blooms for external despatch are lifted from the cooling bed or storage bay by crane and placed onto wagons in bundles or individually. Individual billets have no designed sling point — magnetic crane grab is the standard primary lift tool, but the positioning and lashing work requires direct manual interface with the billet body and the wagon deck structure.

CHAIN & SLING LASHING OPERATIONS

Loaded product is secured with chains, wire rope, or webbing straps before despatch. Chain lashing requires threading the chain through or around the product and securing it to the wagon or trailer anchor points. Chain links, hooks, and tensioners are handled directly throughout — a sustained manual contact task with heavy, sharp-edged metal components under tension.

DUNNAGE & PACKING PLACEMENT

Wooden or rubber dunnage pads are placed between product layers and between product and the wagon/trailer deck before crane loading. Dunnage is positioned by hand with the crane load hovering above the dunnage placement point — the worker's hand in the space the load will occupy moments later. This is the compressed-time version of the plate Retrieve exposure, with a crane load above.

SHIP & BARGE LOADING — PORT OPERATIONS

Where the plant has a port or jetty for coastal or river despatch, product is loaded into ship holds or onto barge decks. The confined hold environment, the crane radius, and the load-swing behaviour during ship-to-hold descent create the same tagline guidance exposure as the finishing bay — at greater crane heights and in a potentially moving platform environment.

3 MANUAL TASKS & HAND EXPOSURE SCENARIOS

ZONE A — CRANE LOADING: COILS, PLATES & SECTIONS

• HIGH • EXPOSURE FREQUENCY

Coil Loading — Final Approach Guidance & Sling Disengagement on Wagon

CRUSH / LINE-OF-FIRE • GUIDE

WHY THE HAND IS THERE	HAND INTERFACE	EXPOSURE TYPE
When a finished coil is lowered onto a flat wagon or truck trailer, the rigger or despatch operative guides the coil during the final approach to the landing position — controlling the coil's lateral position and rotation — and then disengages the sling or C-hook after landing. Guidance during the final approach places the hand between the coil body and the wagon deck or adjacent coil. Sling disengagement requires reaching under the coil body or into the coil eye area while the crane takes the residual weight. This is the Last 300 mm Rule™ in its purest form: the highest-risk phase of the entire lift is the last fraction of the load's travel.	Coil outer wrap during guidance; sling body during disengagement; coil eye inner surface during C-hook disengagement; wagon deck surface during dunnage adjustment after landing	Crush between coil and wagon deck during final approach if coil swings; hand trapped between adjacent coils during multi-coil loading; struck-by from coil swing if guidance hand is between coil body and wagon superstructure
GUIDE "During the final approach of a coil onto the wagon deck, where are the rigger's hands relative to the coil body and the wagon surface — and at what point in the lowering sequence do the hands move out of the coil's landing zone?"		
ENGINEERING INTERFACE CONSIDERATION Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.		

• HIGH • EXPOSURE FREQUENCY

Plate & Heavy Section — Crane Positioning on Wagon & Trailer

CRUSH / STRUCK-BY • GUIDE / CONTROL

WHY THE HAND IS THERE	HAND INTERFACE	EXPOSURE TYPE
Steel plates and structural section bundles are long, flat loads that rotate and swing during crane travel. During lowering onto a wagon or trailer, a rigger guides the plate or bundle into position — controlling the load's angle relative to the wagon bolsters, preventing it from contacting the wagon superstructure or adjacent wagon. The load must be precisely positioned before it lands: once landed, it cannot be moved by hand, and adjustment requires re-slinging. The guidance window — the phase when the load is close to the wagon but not yet down — is where both hands are on the load body.	Plate face or edge during guidance; section bundle wrap during approach; wagon bolster and deck during dunnage positioning with load above; sling leg during disengagement after landing	Crush between plate and wagon bolster during final approach if load swings; struck-by from plate edge if load rotates during guidance; hand on wagon deck during dunnage adjustment with load hovering above
GUIDE "During wagon loading of long plate or section bundles, at what height above the wagon deck is the rigger's hand last in contact with the load body — and is there a standoff tool that maintains guidance from outside the load's landing zone for the final approach?"		
ENGINEERING INTERFACE CONSIDERATION Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.		

• HIGH · EXPOSURE FREQUENCY		
Billet & Bloom — Individual Positioning & Magnetic Handling		CRUSH / PINCH · GUIDE / RETRIEVE
WHY THE HAND IS THERE Individual billets that have rolled off the magnetic crane grab or that require repositioning on the wagon are moved by hand or bar lever — a classic Retrieve scenario for a ferrous component on a flat surface with no designed grip point. Billets being stacked on the wagon may also need manual guidance to prevent roll-off before the next layer is loaded. The billet surface is smooth, the component is heavy and cylindrical, and the wagon surface is often contaminated with scale or lubricant. → <i>Cross-reference LoadGrab® Interaction Library: Cylindrical Components, and Ch.12 (BRM) for billet handling in production context.</i>	HAND INTERFACE Billet body during push/pull repositioning on wagon; billet end during levering; wagon deck during reach-in to contact fallen or misaligned billet	EXPOSURE TYPE Hand crushed between billet and wagon deck if billet rolls during repositioning; hand crushed between adjacent billets during stacking guidance; laceration from scale or sharp billet end
RETRIEVE CONTROL "When a billet needs to be repositioned on the wagon deck after the crane grab has released, is the repositioning done with a bar or tool — or by direct hand contact with the billet body on the deck surface?"		
ENGINEERING INTERFACE CONSIDERATION Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.		

ZONE B — LASHING, DUNNAGE & SLING RETRIEVAL

• HIGH · EXPOSURE FREQUENCY

Chain Lashing — Threading,
Hooking & Tensioning

LACERATION / CRUSH · CONTROL

WHY THE HAND IS THERE

Lashing chains are threaded around, over, and through the loaded product and connected to wagon or trailer anchor points. Chain links are heavy, sharp-edged, and under tension during the final tightening — with the hook engagement and tensioner ratchet work requiring hands in and around the chain link and hook body. The highest-exposure moment is hooking the chain end onto the anchor point with the chain under partial tension from the previous adjustment: the hook slipping off the anchor point while the chain is taut can propel the chain link into the handling hand.

HAND INTERFACE

Chain link body during threading and carry; hook body during anchor point engagement; tensioner ratchet handle during tightening; product surface and deck edge during chain routing

EXPOSURE TYPE

Laceration from chain link edge during handling; crush between chain and wagon anchor bracket during hook engagement; struck-by from chain recoil if hook slips during tensioning; hand pinched in tensioner ratchet during tightening

CONTROL "During chain hook engagement onto the wagon anchor point under partial tension, if the hook slips off the anchor at the moment of engagement, where does the chain recoil — and where are the hands at that moment?"

ENGINEERING INTERFACE CONSIDERATION

Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.

• HIGH · EXPOSURE FREQUENCY

Dunnage Placement — Hand Under
Hovering Crane Load

CRUSH · CONTROL / RETRIEVE

WHY THE HAND IS THERE

Dunnage pads — timber, rubber, or plastic — must be placed on the wagon deck or between product layers before the crane load is lowered onto them. The sequence pressure (crane holding load, truck waiting, train departure time) often results in dunnage being placed or adjusted while the crane load is hovering above the placement zone — centimetres above the worker's hands. This is not a maintenance task or a shutdown scenario. It is an everyday despatch operation in which hands routinely enter the space that a several-tonne load will occupy within seconds.

HAND INTERFACE

Dunnage pad body during placement on deck; wagon deck surface during adjustment; product surface when placing inter-layer dunnage with crane load above

EXPOSURE TYPE

Crush between dunnage and wagon deck or product layer if crane load descends while hands are in the placement zone; hand in line of fire of crane load if communication with crane operator breaks down during placement sequence

CONTROL "During dunnage placement, is there a defined communication and hold protocol with the crane operator that prevents the load from descending until the despatch operative has confirmed hands clear — and is that protocol followed on every lift, not only the first of a shift?"

ENGINEERING INTERFACE CONSIDERATION

Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.

ZONE B — LASHING, DUNNAGE & SLING RETRIEVAL — CONTINUED		
• MEDIUM • EXPOSURE FREQUENCY		
Tagline & Sling Retrieval — After Load Landing		STRUCK-BY / LACERATION • RETRIEVE
WHY THE HAND IS THERE	HAND INTERFACE	EXPOSURE TYPE
After a load has been set down on the wagon or trailer, the crane sling or tagline must be disengaged and retrieved. For slings passed under or around the load, the sling tail must be pulled clear — requiring the worker to reach between the product and the deck surface, or between adjacent products, to retrieve the sling body. For taglines, the rope end must be physically walked back to the crane hook or pooled on the wagon deck. Both involve hands in the space between a landed load and a transport surface, or between a product and the adjacent product.	Sling tail during under-product retrieval; tagline body during walk-back; crane hook during sling re-engagement for next lift	Hand crushed between sling and product if sling is pulled with load weight still on it; struck-by from sling or tagline recoil if sling jams and releases under tension; hand in line of fire of crane hook if hook is lowered during sling retrieval sequence
RETRIEVE "During sling retrieval from under a landed load, has the full load weight transferred from the sling to the wagon deck and been confirmed before the sling retrieval begins — and is the sling pulled with a tool rather than by reaching under the load body by hand?"		
ENGINEERING INTERFACE CONSIDERATION Consider whether this task can be redesigned using an appropriate PSC Engineering Interface to reduce direct hand exposure. See the PSC Engineering Interface Portfolio in this chapter and contact PSC Hand Safety India for application-specific guidance.		

4 ADDITIONAL EXPOSURE — SHIP LOADING & CONTRACTOR OPERATIONS

TASK	HAND EXPOSURE	FREQ.	EXPOSURE	PSC ENGINEERING INTERFACE CATEGORY
Ship / barge hold loading	Product lowered into ship hold by shore crane or ship's gear; hold environment is confined and the crane radius is greater than a bay crane; load swing during descent into hold requires extended-reach guidance at the hold opening and inside the hold at landing	LOW	CRUSH / STRUCK-BY	PSC Load Control Interfaces · PSC Position & Reach Interfaces
Steel coil — strapping & wrapping	Coil wrapping and steel strapping before despatch; strapping tensioner and seal crimping work with hands on and around the coil outer wrap; strap under tension if tensioner slips during crimping	MED	LACERATION / CRUSH	PSC Specialised Maintenance Interfaces · PSC Striking & Alignment Interfaces
Forklift interface — product loading on yard	Forklift loading of bundled sections or palletised product onto trailers; worker guides product during approach and forks into the load at the final seating point	HIGH	CRUSH	PSC Manual Lifting Interfaces · PSC Position & Reach Interfaces
Rail wagon — draw hook coupling	Draw hook and shackle coupling between wagons in the despatch yard; shackle pin and clevis work by hand between buffers; hand in the coupling zone during wagon movement for positioning	MED	CRUSH	PSC Specialised Maintenance Interfaces · PSC Striking & Alignment Interfaces

6 DESPATCH & LOGISTICS QUICK ASSESSMENT CHECKLIST

- ☐ During coil loading onto a wagon, at what height above the deck does the rigger's hand last contact the coil body — and is a tagline or pole used to maintain control for the remainder of the approach?
- ☐ During plate or section bundle loading, is a standoff tool used to guide the load through its final approach — or are both hands on the load body at the moment it contacts the wagon deck?
- ☐ When a billet needs repositioning on the wagon deck after crane release, is a tool used to move it — or is the billet pushed or levered by direct hand contact on the deck surface?
- ☐ During chain lashing, when the hook is engaged on the anchor point under partial chain tension, are the hands positioned clear of the chain recoil path if the hook slips?
- ☐ During dunnage placement, is there a confirmed hold signal to the crane operator before any hand enters the load's landing zone — and is that signal protocol followed on every lift, not only the first?
- ☐ During sling retrieval from under a landed load, has full load transfer to the deck been confirmed before the sling is pulled — and is the sling retrieved with a tool rather than by reaching under the load body?

If you answered **Yes** to any of the above, PSC can review those tasks and recommend representative hands-free interfaces. Contact Shivani at **+91-96031-66448** or **sales@pschandsafety.com**

7 PSC ENGINEERING INTERFACE PORTFOLIO — MATERIAL HANDLING, LOGISTICS & DESPATCH

The following PSC engineering interfaces are relevant to the hand exposure scenarios identified in this chapter. This table introduces PSC product families and their primary engineering functions. It does not map any product to a specific scenario or application.

PSC LOAD CONTROL INTERFACES		
PSC ENGINEERING INTERFACE	PRIMARY FUNCTION	REPRESENTATIVE PART NUMBERS
PSC LoadGuider® Anti-Tangle Tagline	Controls suspended loads from a safe distance during crane operations	PSC-LGTC-15 PSC-LGTC-20 PSC-LGTC-25 PSC-LGTC-30
PSC Guidelt® Safety Rigger Tagline	Provides a safe, reusable tagline interface for controlling suspended loads from a stand-off distance throughout the lifting operation	PSC-GISRT-10 PSC-GISRT-15
PSC RiggerMate® Hook	Positions slings, shackles and rigging components without direct hand contact on rigging	PSC-RMH
PSC TaglineRetriever	Retrieves tagline rope ends after load landing without the operator entering the load zone	PSC-TRT PSC-TRT-3P
PSC POSITION & REACH INTERFACES		
PSC ENGINEERING INTERFACE	PRIMARY FUNCTION	REPRESENTATIVE PART NUMBERS
PSC LoadGuider® Push/Pull Pole	Pushes and pulls loads, components and rigging at a safe standoff distance	PSC-LG-42 PSC-LG-50 PSC-LG-72 PSC-LG-96
PSC Guide-It® Push/Pull Pole	Heavy-duty extended-reach push/pull for higher-force load guidance and positioning	PSC-GIT-50 PSC-GIT-72 PSC-GIT-96
PSC Load-It® Push/Pull Tool	Positions, guides and controls components using interchangeable heads suited to specific load geometries	PSC-LIT-S004 PSC-LIT-S006 PSC-LIT-S008
PSC SafeGuider Tool	Provides controlled standoff access to confined, hot or hazardous locations during maintenance	PSC-STGT-36 PSC-STGT-48
PSC MAGNETIC HANDLING INTERFACES		
PSC ENGINEERING INTERFACE	PRIMARY FUNCTION	REPRESENTATIVE PART NUMBERS
PSC Magnetic Lifter — Standard	Lifts and retrieves ferrous components from surfaces without fingers beneath the load	HSF-MG004 HSF-MG005
PSC MagHead Lifter	Retrieves ferrous components from confined or restricted locations with 360°/180° articulation	HSF-LG-001
PSC Magnetic Hand Lifter	Retrieves small ferrous components, sheet metal and freshly cut plate from surfaces	HSF-LG-MHL
PSC Multi-Grab Magnetic Handler	Handles individual ferrous components on workshop floors and decks with 360° rotation and lever release	MG004
PSC STRIKING & ALIGNMENT INTERFACES		
PSC ENGINEERING INTERFACE	PRIMARY FUNCTION	REPRESENTATIVE PART NUMBERS
PSC FingerSaver®	Holds slogging spanners, drifts, chisels and punches during hammer striking, keeping the holding hand outside the impact zone	PSC-FS-295 PSC-FS-375 PSC-FS-850
PSC Chisel & Punch Holder	Holds narrow chisels and punches during light hammer striking where a smaller holding interface is required	PSC-CPH
PSC SPECIALISED MAINTENANCE INTERFACES		
PSC ENGINEERING INTERFACE	PRIMARY FUNCTION	REPRESENTATIVE PART NUMBERS
PSC GasGrab® Cylinder Mover	Moves gas cylinders without tilt-and-roll, protecting the valve and removing the hand from the cylinder body	PSC-GG-152 PSC-GG-230 PSC-GG-254
PSC Grapppler Hook Tool	Engages chains, hooks and lashing components without fingers in the hook or link zone	PSC-GRA001-28 PSC-GRA001-40

Selection of the appropriate engineering interface depends on the specific application, load characteristics, work method and site conditions. **Contact PSC Hand Safety India for application-specific engineering guidance and product recommendations.**

— APPLICATION-SPECIFIC ENGINEERING GUIDANCE

If any hand exposure scenario in this chapter reflects tasks in your plant or maintenance team, PSC Hand Safety India can provide application-specific engineering guidance. Bring the task, the component, the work method, and the site conditions — PSC will identify the most appropriate engineering interface for your specific application.

TO RECEIVE APPLICATION-SPECIFIC GUIDANCE, DESCRIBE:

1. The specific task or operation
2. The equipment type and component
3. The component weight and geometry
4. Whether the component is ferrous
5. The work method currently in use
6. The frequency of the task
7. The working environment and access constraints
8. Your plant name and location

ENGINEERING GUIDANCE

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HSF doctrine & RiggerSafe® guidebook

Hand Exposure in Integrated Steel Plants — A Department-by-Department Engineering Reference

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Chapter 22 of 22 · Version 2

ENGINEER THE HAND OUT OF THE HAZARD™

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APPENDIX A

PSC Engineering Interface Library

A structured reference to the six PSC Engineering Interface Families — the engineering framework underpinning hand exposure control across integrated steel plants and heavy industrial facilities.

This appendix documents the engineering rationale, design principles, and representative product interfaces across six families of PSC engineering control. Each family addresses a specific class of hand exposure arising from the structural conditions of industrial work — the geometric, mechanical, or task-driven realities that place hands in the hazard zone. **The framework reflects the PSC doctrine that the engineering objective is always to place a tool, device, or mechanical system between the worker's hand and the hazard — not to instruct the worker to be more careful.**

SIX ENGINEERING INTERFACE FAMILIES — THIS APPENDIX

F1	PSC Load Control Interfaces	F2	PSC Position & Reach Interfaces
F3	PSC Manual Lifting Interfaces	F4	PSC Striking & Alignment Interfaces
F5	PSC Magnetic Handling Interfaces	F6	PSC Specialised Maintenance Interfaces

CORE DOCTRINE

"Engineer the Hand Out of the Hazard™"

THE LAST 300 MM RULE™

The final 300 mm of any manual interaction is where most hand exposure events occur. That zone must be bridged by a tool, not by a bare hand.

NO SLOGGING WITHOUT THE TOOL™

When there is no engineered interface, the worker becomes the interface. The engineering objective is to ensure that situation does not arise.

F1 Engineering Interface Diagram

"Control the load through the interface — not through the hand."

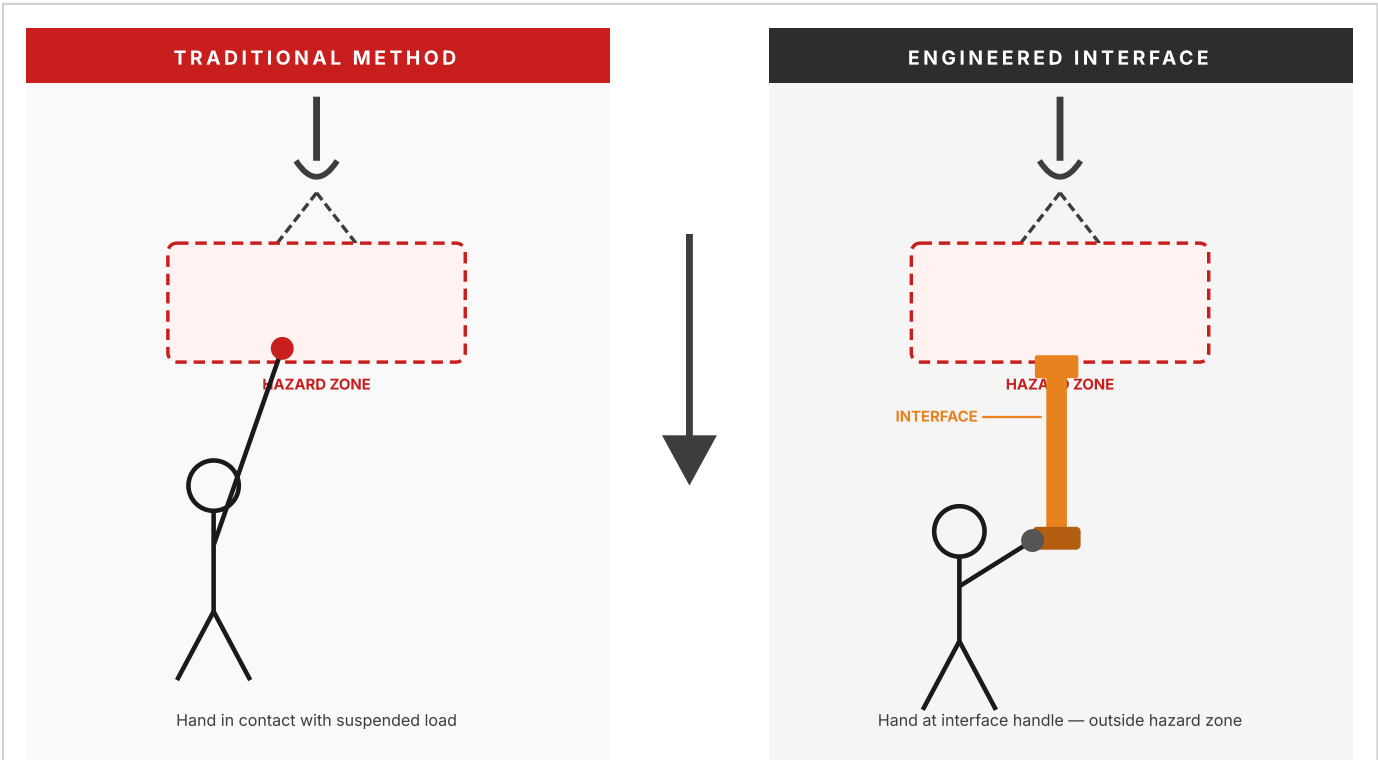


Figure A:F1 — Traditional: hand contacts suspended load. Engineered: interface provides standoff — hand at handle, outside hazard zone.



PSC ENGINEERING INTERFACE FAMILY 1

PSC Load Control Interfaces

Engineering interfaces that position a mechanical or structural element between the worker's hand and a suspended, slewing, or translating load — eliminating the requirement for direct hand contact during load management operations.

1 · ENGINEERING OBJECTIVE

The engineering objective of the Load Control Interface family is to **eliminate direct hand contact with suspended loads, rigging hardware, and load faces during any phase of lift, travel, landing, or adjustment.**

A load in motion is an unpredictable system. Oscillation, yaw, spin, and slewing are all conditions that cannot be fully controlled from the crane cabin alone. The conventional industrial response — having riggers and handlers apply hands or body mass to slow, guide, or stop a load — places the worker directly in the line of movement energy. The engineering response is to introduce a rigid, extended, or mechanically isolated interface that the worker operates from outside the load's movement envelope.

Load Control Interfaces do not replace riggers. They **reposition the rigger's point of interaction** — from contact with the load face or rigging hardware, to contact with the proximal end of a handling tool that itself interacts with the load.

2 · STRUCTURAL REASON THE HAND EXPOSURE EXISTS

The structural conditions that create hand exposure in load-handling operations are largely independent of worker skill or experience. They arise from the physics and geometry of the work itself:

- **Suspended load pendulum dynamics.** Any freely suspended load behaves as a pendulum during slewing and travel. Momentum continues after the crane stops. Riggers stationed at ground or platform level attempt to absorb this energy with their bodies and hands.
- **Load face geometry.** Steel billets, plate, coils, and fabricated assemblies rarely present a safe handhold. Hands are placed against flat faces, edges, corners, or rigging hardware — all of which can trap, crush, or shear on unexpected load movement.
- **Proximity requirements of conventional practice.** Landing a load accurately in a confined bay, aligning a component for bolting, or preventing a coil from swinging into racking — all conventionally require the rigger to be within arm's reach of the load at the moment of maximum hazard.
- **Communication and reaction gaps.** The geometry of many steel plant bays means the crane operator has limited or indirect sightlines to the landing zone. The rigger is simultaneously the load guide and the point of control — often using hand signals while in physical contact with the load.

3 · HAND EXPOSURE ADDRESSED

Load Control Interfaces are designed to address the following primary hand exposure mechanisms:

CRUSHING Hand between load and fixed structure, rack, or floor during landing or slewing.	STRUCK-BY Oscillating or spinning load contacting the worker's hand or arm during stabilisation.	PINCH / TRAP Hand caught between load and rigging hardware, hook block, or hook body on settling.
SHEAR / CUT Load edge or coil edge moving across hand or fingers during rotation or tilting.	LINE-OF-FIRE Hand positioned in the trajectory of a load that shifts under load redistribution or sling slip.	ENTANGLEMENT Glove or hand caught in rigging during hook approach or load lift-off.

Across the 22 chapters of this manual, load-guiding hand contact was identified as a recurring exposure in Rolling Mill bays, Plate Mill transfer operations, Continuous Casting dummy bar handling, Blast Furnace cast house crane operations, and SMS ladle and electrode assembly lifts. The common factor in each case was the structural absence of a mechanical interface between the worker and the load at the critical moment of positioning.

4 · TYPICAL INDUSTRIAL INTERACTIONS

Load Control Interfaces are applicable wherever a worker is required to guide, steady, position, or prevent rotation of a suspended or translating load. The following interaction types are typical across integrated steel plant operations:

INTERACTION TYPE	INDUSTRIAL CONTEXT	WITHOUT INTERFACE
Suspended load stabilisation	Slabs, billets, blooms, coils, and fabricated assemblies guided to landing in rolling mill bays and stockyards	Bare-hand or body contact with load face or rigging; hand in pendulum trajectory
Anti-spin / anti-rotation	Long products (bars, pipes, rail) that yaw or rotate during crane travel; coils that spin on hook	Rigger grips load end or sling to apply corrective torque; hands on moving surface
Load landing and alignment	Positioning plate on transfer cars, saddles, and inspection tables; aligning components for assembly	Rigger stands at load face and pushes or pulls to achieve alignment; crush zone active
Confined-bay load management	Narrow SMS and CCM bays where loads must be threaded between fixed structures	Rigger guides load from within the envelope using hands against load or rigging hardware
Coil and plate edge management	Hot-rolled coils, plate packs, and sheet bundles moved in coil yards and plate mills	Rope or bare-hand contact with load edge; edge and shear exposure during any load movement
Hook and shackle approach	Rigging attachment in all departments — the hook block descending to the lift point	Hands on hook body, pin, or shackle while hook block oscillates; trap and crush risk

5 · ENGINEERING AND DESIGN PRINCIPLES

Load Control Interfaces are not simply poles or hooks. Their engineering value lies in the principles embedded in their design. Six principles govern effective load control interface design:

Standoff Distance The interface must place the worker's hands outside the load's movement envelope at all times. The working length of the interface defines the standoff. In most steel plant applications, a minimum standoff of 1.5 m is required to position the rigger outside the struck-by zone for loads in the 1–50 tonne range.	Force Transmission Without Body Proximity The interface must be capable of transmitting the stabilising, steering, or braking force required to control the load — without requiring the worker to be positioned adjacent to or in contact with the load. Rigidity, length, and tip geometry all contribute to force transmission efficiency.
Tip Geometry Matched to Load Characteristic The distal end of a Load Control Interface must be engineered for the specific load interaction it is performing. A hook tip engages rigging. A flat-face tip pushes a load face. A fork tip manages coil or edge geometry. Generic tip design reduces control and increases the risk of slip or loss of contact at the critical moment.	Rigidity Under Load Reaction When a load reacts — swings, spins, or translates unexpectedly — the interface will experience a sudden force input at the tip. A well-designed interface transmits this force along its axis to the worker's hands rather than buckling, deflecting, or becoming uncontrollable. Wall thickness, cross-section geometry, and material selection all contribute.
Worker Ergonomics at Operating Length The interface must be manageable at full operating length — in terms of weight, balance, and grip. An interface that is theoretically adequate in standoff distance but impractical to hold and manoeuvre for a full shift will be set aside by workers in favour of closer-contact methods. Weight, grip diameter, and handle design are not secondary considerations.	Durability in Industrial Environments Steel plant environments combine scale impact, heat, contamination, and corrosion. Load Control Interfaces must sustain their functional characteristics across these conditions. Tip integrity, surface finish, and joint security (for telescopic or modular designs) are key durability considerations in the steel plant context.

6 · TYPICAL APPLICATIONS ACROSS STEEL PLANT DEPARTMENTS

DEPARTMENT	OPERATION	EXPOSURE WITHOUT INTERFACE	INTERFACE ROLE
Hot Strip Mill / Rolling	Coil transfer and coil yard management; crane-slung coil positioning onto saddles	Rigger in contact with rotating coil face or sling during positioning	Standoff guide and stabiliser
Plate Mill	Plate landing on transfer cars and inspection tables; alignment of plate packs for bundling	Hands on plate face or edge; crush exposure at landing	Load face guide; anti-rotation
Steel Melt Shop (SMS)	Electrode assembly lifts; ladle component handling; EAF roof swing; furnace bay crane operations	Rigger hand-steadies load in confined furnace bay; thermal and crush exposure	Thermal standoff; load steering
Continuous Casting (CCM)	Dummy bar handling; ladle turret area; tundish positioning; mould component lifts	Hand contact with hot or heavy components in constrained casting bay	Reach extension; thermal separation
Blast Furnace Cast House	Trough section replacement; taphole drill and mud gun handling; equipment lifts at cast house floor	Contact with heavy, irregular components in high-temperature, confined environment	Standoff; component control in line-of-fire
Raw Material Handling	Grab bucket maintenance; conveyor idler and belt component crane handling; stockyard operations	Workers steady components by hand during lowering; rigging hardware contact	Anti-pendulum; positioning control
Shipping / Dispatch	Finished product loading — plate, coil, long product — onto rail wagons and road vehicles	Rigger at load face during final positioning; crush and shear exposure at vehicle	Final-metre load control; anti-swing

APPENDIX A · CONTINUED

F1 · Load Control Interfaces

7 · REPRESENTATIVE PSC ENGINEERING INTERFACES

The following represent the principal Load Control Interfaces within the PSC portfolio, each addressing a defined class of load interaction. Product profiles are representative; confirmed design characteristics are drawn from validated manual content.

HSF LoadGrab® Suspended Load Guide Poles

A range of rigid and semi-rigid poles engineered to guide, stabilise, and anti-rotate suspended loads from worker standoff distance, eliminating the requirement for direct hand contact with load faces, slings, or rigging hardware during crane operations.

PRIMARY ENGINEERING FUNCTION

Suspended load stabilisation and directional control. Places the worker's point of force application at the proximal end of the pole, physically separated from the load interaction point by the working length of the tool.

DESIGN CHARACTERISTICS

- › Extended working length creates standoff between worker hand and load face
- › Hook and flat-face tip options matched to load geometry and interaction type
- › Ergonomic grip handle positioned to enable two-handed control at operating length
- › Structural rigidity maintained under load reaction forces typical of suspended load contact

HSF LoadGrab® Tag Line System

A mechanical tag line assembly providing directional control of suspended loads from a defined standoff, replacing hand-held rope tag lines that allow load oscillation to be transmitted directly to the worker's body.

PRIMARY ENGINEERING FUNCTION

Anti-pendulum and anti-rotation control for loads in transit. Provides a managed tensile connection between the load and the worker's control position — without requiring the worker to absorb load energy through unprotected hands or arms.

DESIGN CHARACTERISTICS

- › Engineered connection to load rigging — not a freehand rope loop or improvised line
- › Handle design separates worker grip from tensile load path
- › Suitable for long-product, coil, and flat-face load geometries
- › Compatible with LoadGrab® pole system for combined stabilisation operations

HSF LoadGrab® Coil Control Pole

A specialist pole variant with coil-face tip geometry designed for hot-rolled coil and wire rod coil positioning, where the combination of coil weight, residual heat, and rotation risk creates a compound hand exposure during crane operations in coil yards and strip mill bays.

PRIMARY ENGINEERING FUNCTION

Anti-rotation and anti-pendulum control specific to coil geometry. Tip engages the coil face without requiring hand approach to the coil edge or sling attachment point.

DESIGN CHARACTERISTICS

- › Coil-face tip profile matched to standard hot-rolled coil diameters
- › Operating length appropriate for coil yard and strip mill bay geometries
- › Heat-tolerant handle materials suitable for use in proximity to warm product
- › Grip configuration enables lateral force application for coil rotation correction

HSF LoadGrab® Hook Approach Tool

An interface engineered for the crane hook approach and rigging attachment phase — the moment when the descending hook block must be received, steadied, and positioned for shackling without hand contact with the moving hook body or hook block.

PRIMARY ENGINEERING FUNCTION

Eliminates hand contact with the oscillating hook block during rigging. Provides a controlled mechanical interface between the worker and the hook at the moment of highest kinetic energy and lowest predictability.

DESIGN CHARACTERISTICS

- › Hook engagement tip geometry matched to standard crane hook profiles
- › Working length positions worker hands outside hook block oscillation radius
- › Suitable for all rigging environments including confined CCM and SMS bays
- › Compatible with existing shackling and rigging workflow — no process redesign required

8 · SELECTION CONSIDERATIONS

Selecting the appropriate Load Control Interface requires assessment across six dimensions. The right interface is not simply the longest available tool — it is the interface whose standoff distance, tip geometry, rigidity, and ergonomic characteristics most closely match the specific load, environment, and interaction type encountered.

LOAD GEOMETRY What is the load's shape, surface condition, and rigging attachment configuration? Flat-face loads (plate, slab) require different tip geometry than cylindrical loads (coil, pipe) or irregular loads (fabricated assemblies, equipment). Match tip design to the specific load face the worker will be engaging.	HAZARD ZONE RADIUS What is the pendulum or swing radius of the suspended load at the operating height and speed used? The working length of the selected interface must place the worker's hands outside this radius at the point of load contact. For large loads in high-bay operations, standoff requirements typically exceed 2 m.	INTERACTION TYPE Is the primary task stabilisation, anti-rotation, directional steering, landing alignment, or hook approach? Each interaction type has a different force vector and tip engagement requirement. Multi-task operations may require a combination of interface types within the same lift sequence.
ENVIRONMENTAL CONDITIONS Does the operation involve heat, confined space, elevated platform, or wet/contaminated surfaces? Thermal proximity affects handle material requirements. Confined bays limit available manoeuvrability and may constrain maximum working length. Elevated platforms affect centre of gravity management for longer poles.	SHIFT DURATION AND PHYSICAL DEMAND How frequently is the interface used per shift, and for what cumulative duration? A tool that is ergonomically adequate for occasional use may impose unacceptable physical demand if load-guiding is a continuous task across a full shift. Weight, balance, and grip diameter must be evaluated against realistic task frequency.	COMPATIBILITY WITH EXISTING RIGGING PRACTICE The interface must integrate with the plant's established rigging workflow — crane communication systems, signal protocols, tag-out procedures, and rigging hardware standards. An interface that requires significant workflow redesign will face adoption barriers. Assess fit with existing practice and identify any adaptations required before deployment.

ENGINEERING PRINCIPLE — FAMILY 1

"In load-handling operations, the worker's hands should never be the mechanism by which a load is guided, slowed, stopped, or positioned. That function belongs to an engineered interface. When no interface exists, the worker becomes the interface — and that is the exposure event waiting to happen."

PSC Engineering Doctrine · Hand Exposure in Integrated Steel Plants, Version 2.0

CONTINUES AT

Appendix A · Family 2 — PSC Position & Reach Interfaces

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PSC ENGINEERING INTERFACE FAMILY 2

PSC Position & Reach Interfaces

Engineering interfaces that extend the worker's effective reach, transfer positioning force, or redirect manual effort — so that the hand remains outside the pinch zone, crush zone, or line-of-fire during the final stage of any positioning, alignment, or separation task.

1 · ENGINEERING OBJECTIVE

The engineering objective of the Position & Reach Interface family is to **transfer the worker's positioning force to the point of interaction — without requiring the hand to enter the hazard zone to do so.**

Most positioning tasks are not dangerous in principle. Moving a component from one location to another, aligning a part for bolting, separating two mating surfaces — these are ordinary industrial activities. The exposure arises not from what the task requires, but from where the hand must be to perform it using conventional methods. The hand does not need to be at the point of contact. It needs to be at the point of control. Those are rarely the same place. Position & Reach Interfaces close that gap. They carry the worker's intent — the push, pull, pry, or alignment force — to the interaction point through an engineered shaft, lever, or extension, while the worker's hands remain at a safe remove.

2 · STRUCTURAL REASON THE HAND EXPOSURE EXISTS

Hand exposure in positioning tasks is structurally predictable. It arises from three conditions that recur across nearly every department in an integrated steel plant:

Geometry of access. The interaction point is in a confined space, behind a flange, beneath a structure, or inside a machine opening. The only tool that fits is a hand.

The last few millimetres. Components that are 95% positioned still require precise final adjustment. That adjustment is typically made by hand — directly on the component face, in the zone where crush or pinch hazards are most active.

The absence of a designed interface. Most industrial components are not designed with a positioning interface. There is no handle, no lug, no recessed grip. The worker improvises — using fingers, a bar, or body weight — because the component itself offers nothing better.

3 · HAND EXPOSURE ADDRESSED

Position & Reach Interfaces address the following primary exposure mechanisms, which were identified repeatedly across the 22 chapters of this manual:		
Pinch / Trap Fingers between component and mating surface during final alignment or assembly.	Crush Hand between two converging surfaces during positioning — flanges, housing covers, roll assemblies.	Shear Component edge moving across hand or fingers during separation or prying tasks.
Line-of-Fire Hand in the path of a component that releases unexpectedly under spring load or gravity.	Overexertion Excessive grip or push force applied with poor hand posture in confined-access positioning.	Contact / Abrasion Hand in contact with rough, sharp, or hot surfaces during reach-in retrieval or adjustment.
These exposures are not the result of carelessness. They are the predictable outcome of a situation in which the worker has no engineered alternative to placing the hand at the interaction point. The structural solution is not a procedure — it is an interface.		

F2 Engineering Interface Diagram

"Move the point of control away from the point of contact."

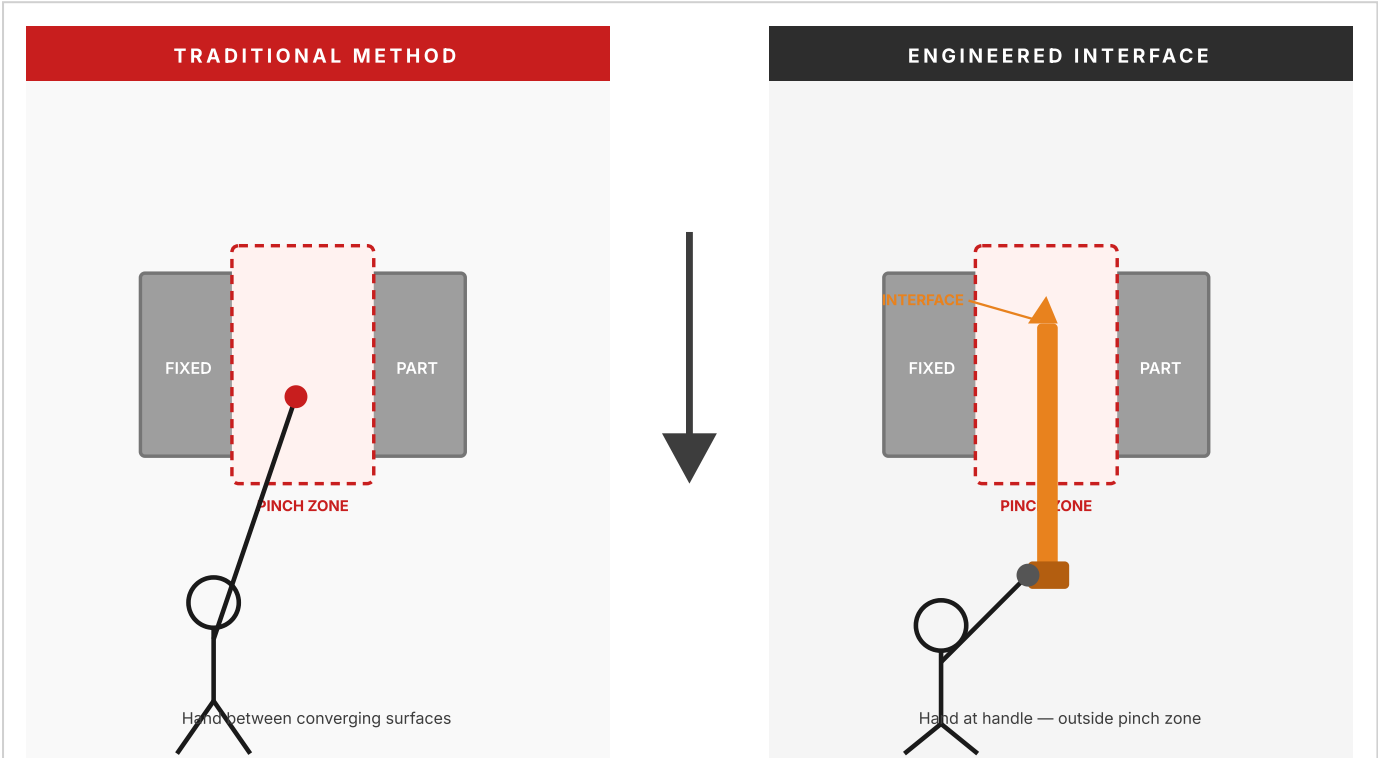


Figure A-F2 — Traditional: hand in pinch zone between converging surfaces. Engineered: interface transfers positioning force — hand outside pinch zone.

4 · TYPICAL INDUSTRIAL INTERACTIONS

The following interaction types represent the most common positioning and reach tasks in which hand exposure arises from the absence of an engineered interface:

INTERACTION TYPE	INDUSTRIAL CONTEXT	WITHOUT INTERFACE
Final-metre alignment	Bolted flange, coupling, bearing housing or structural assembly — last stage of positioning before fastening	Fingers used to close final gap; hand between converging surfaces
Component separation / prying	Removing stuck flanges, covers, worn liners, conveyor components or press-fit parts	Bar or hand applied directly to component; sudden release places hand in line-of-fire
Confined-space adjustment	Reaching behind guards, inside housings, through machine openings or into recesses to reposition a component	Hand inserted into confined geometry; limited visibility and control
Rotation and orientation	Turning a component to a required clock position before assembly — valves, pipe fittings, couplings, pulleys	Hands grip component directly; force applied at the component face or edge
Push / pull during installation	Sliding components into position on shafts, rails, guides or frames during maintenance or commissioning	Hands push directly on component end; hand in line-of-fire if component releases
Wedge and spacer placement	Inserting shims, wedges or packers into narrow gaps during alignment or levelling	Fingers enter the gap directly; crush and pinch exposure if surfaces shift

5 · ENGINEERING AND DESIGN PRINCIPLES

A positioning tool is not a stick with a handle. It is a force-transmission system — and the geometry of that transmission determines whether the hand remains safe or enters the hazard.

Reach Extension Without Proportional Mass
Extending the worker's reach increases standoff. But an interface that extends reach by adding proportional mass creates a different problem — fatigue and loss of fine control. Effective Position & Reach Interfaces are engineered to extend reach while managing weight distribution, so that control is maintained at full working length.

Tip Geometry Matched to the Interaction
A flat tip pushes a component face. A hook tip pulls an edge or recessed feature. A fork tip straddles a shaft or bar. A chisel tip enters a gap without requiring finger insertion. Generic tip designs attempt to serve all interactions and serve none well. Purpose-specific tip geometry improves both effectiveness and safety.

Ergonomic Usability at Working Geometry
Many positioning tasks require the worker to apply force from an awkward stance — reaching overhead, working from the side, operating in a confined bay. The interface must remain controllable in these conditions. Grip design, handle angle, and balance all affect whether the interface will be used consistently or set aside.

Force Transfer at the Distal End
The interface must deliver the worker's intent — push, pull, pry, or align — to the interaction point without energy loss through flex or deflection. For alignment tasks, tip rigidity is critical. For prying tasks, lever geometry determines the mechanical advantage available and the likely direction of force release.

Control Maintained During Release Events
Stuck components release suddenly. Spring-loaded assemblies snap open. Press-fit parts shift without warning. A well-designed Position & Reach Interface anticipates the release event — its geometry, grip, and length ensure that when the component moves, the worker's hands are outside the resulting line-of-fire.

Integration with Existing Workflow
Position & Reach Interfaces succeed when they slot into the existing work sequence without adding steps. An interface that requires the worker to reconfigure the task around the tool will be abandoned. The interface should perform the same function as the hand — at a safer distance — with no additional process complexity.

6 · TYPICAL APPLICATIONS ACROSS STEEL PLANT DEPARTMENTS

DEPARTMENT	OPERATION	EXPOSURE WITHOUT INTERFACE	INTERFACE ROLE
Rolling Mills (HSM / CCM)	Roll assembly alignment; coupling engagement; guide adjustment inside mill housings	Fingers used for final alignment in pinch-point zone between roll and housing	Final-metre alignment; confined-space reach
Mechanical Maintenance	Bearing housing cover removal; gearbox component separation; drive coupling engagement	Bar or hand applied to stuck surfaces; sudden release with hand in line-of-fire	Controlled prying; force transfer at release point
Conveyor Systems	Idler and roller replacement; skirt rubber positioning; belt tracking adjustment	Hands reach into pinch zone between belt and idler frame during installation	Reach extension; component positioning from safe standoff
Steel Melt Shop	Electrode clamp adjustment; ladle slide gate component positioning; alloy chute alignment	Hands in confined furnace bay geometry; thermal and crush exposure during adjustment	Thermal standoff; precision reach in confined geometry
Blast Furnace	Tuyere stock and blow pipe alignment; taphole drill bit engagement; bell-less top component adjustment	Hands on heavy, hot components in constrained cast house geometry during positioning	Alignment reach; component separation from safe distance
Plate & Section Mill	Roll guide installation; edger guide adjustment; shear blade positioning; table roller alignment	Fingers between guide and roll during final positioning; crush at guide engagement	Guide positioning; confined-space alignment
Sintering & Pelletising	Pallet wheel and grate bar replacement; wind box and expansion joint component adjustment	Hands on hot or heavy components in restricted geometry during change-out	Component separation; positioning reach extension

APPENDIX A · CONTINUED

F2 · Position & Reach Interfaces**7 · REPRESENTATIVE PSC ENGINEERING INTERFACES**

The following represent the principal Position & Reach Interfaces within the PSC portfolio. Each addresses a defined class of positioning, alignment, or separation interaction.

PSC Load-it Push/Pull Tool

A push/pull pole engineered to guide, manoeuvre, and position loads and components from worker standoff — transferring directional force to the interaction point without requiring hand contact with the load or component surface.

Primary Engineering Function

Force transfer for positioning and alignment interactions. The worker applies push or pull force at the proximal handle; the tool delivers that force at the distal tip — physically separating the worker's hands from the surface being moved or aligned.

Design Characteristics

Working length positions hands outside the pinch and crush zone at full engagement

Interchangeable head options to match the specific load surface or interaction type

Structural rigidity maintains force transfer accuracy without flex under working load

Suitable for load guiding, component positioning, and alignment tasks across industrial maintenance

Compatible with both ferrous and non-ferrous component surfaces

PSC Load-it — Hook Head Variants (J / T / L)

Purpose-configured hook heads for the Load-it system, enabling precise single-point engagement with bolt holes, lifting eyes, flange faces, recessed features, and component edges — for pulling, rotating, and alignment tasks where broad surface contact is insufficient.

Primary Engineering Function

Point-specific force application for pulling, rotating, and alignment interactions. Hook geometry enables the worker to engage a defined feature on the component and apply directional force accurately — without hand contact at the engagement point.

Design Characteristics

J Hook — single-point engagement through bolt holes, lifting eyes, and recessed features

T Hook — dual-engagement for pulling actions where slip prevention is required

L Hook — angled reach for engagement from below or the side in confined geometry

Compatible with Load-it pole system for consistent handle and grip ergonomics across variants

PSC Load-it MagHead Extendable Push/Pull Tool

An extendable push/pull tool with a magnetic head that attaches positively to ferrous load surfaces — providing slip-resistant directional control for positioning, alignment, and guiding tasks where a conventional push tip may lose contact on curved or irregular surfaces.

Primary Engineering Function

Magnetic-contact force transfer for ferrous component positioning. Where a standard push pad may slide off a curved or contaminated ferrous surface, the MagHead maintains consistent contact throughout the positioning or alignment action — keeping the worker's hands clear throughout.

Design Characteristics

- Magnetic head provides positive, slip-resistant attachment to ferrous surfaces
- Extendable shaft increases standoff for confined-bay and elevated positioning tasks
- Suitable for motor casings, gearbox housings, structural sections, and plate positioning
- Extends the reach range beyond that of a standard fixed-length push/pull pole

PSC TubularGuider

A specialist push/pull tool configured for tubular and cylindrical component handling — guiding, positioning, and manoeuvring pipes, tubes, and bar stock without direct hand contact with the cylindrical surface during movement or alignment.

Primary Engineering Function

Cylindrical surface positioning and reach. Where pipes, tubes, and rods must be guided into position, threaded through openings, or aligned for coupling — the TubularGuider transfers the required directional force without the worker gripping or contacting the cylindrical surface directly.

Design Characteristics

- Head geometry configured for cylindrical surface engagement without slippage
- Suitable for pipe rack management, tubular guiding, and bar stock positioning
- Working length provides standoff appropriate for conveyor, rack, and bay geometries
- Applicable across steel plant pipe handling, mechanical maintenance, and utility installation

8 · SELECTION CONSIDERATIONS

Selecting the appropriate Position & Reach Interface begins with understanding the interaction — not the component. The questions below guide that analysis.

Where is the hand at the moment of exposure?

Map the precise hand position at the critical stage of the task. Is it between two converging surfaces? Inside a machine opening? In contact with a component face that may shift? The location of the hand at the exposure moment determines the standoff the interface must provide.

What force or motion must be delivered?

Is the task a push, pull, pry, rotation, or precise alignment? Each force vector has different requirements for tip geometry, lever arm, and grip design. Matching the interface to the primary force type is the single most important selection criterion for Position & Reach tools.

What is the release risk?

Does the component hold energy — spring load, friction lock, gravity — that will release suddenly when freed? If so, the interface must be selected for its ability to manage that release event, ensuring hands are outside the resulting line-of-fire when the component moves.

What are the access constraints?

Can the interface approach the interaction point in a straight line, or must it navigate around guards, flanges, or structural members? Confined-access tasks may require angled tips, articulating joints, or reduced-diameter shaft sections to reach the interaction point without requiring hand insertion.

How much precision is required?

Rough separation tasks tolerate flex and deflection. Final-millimetre alignment tasks do not. Select interface rigidity in proportion to the precision required at the distal tip. An interface that flexes under working load cannot deliver the positional accuracy needed for close-tolerance assembly operations.

Will the interface be used consistently?

An interface that is ergonomically uncomfortable, too heavy for sustained use, or difficult to store at the point of use will be set aside. Assess how the interface integrates with the work environment — storage location, access to the interface at task start, and suitability for the worker's operating stance and available space.

ENGINEERING PRINCIPLE — FAMILY 2

"The most common positioning accident in industrial maintenance is not a dramatic event. It is a worker's fingers caught between two converging surfaces in the final few millimetres of a routine task — a task performed hundreds of times before without consequence. The Last 300 mm is where Position & Reach Interfaces operate. That is precisely where they are needed most."

PSC Engineering Doctrine · Hand Exposure in Integrated Steel Plants, Version 2.0

CONTINUES AT

Appendix A · Family 3 — PSC Manual Lifting Interfaces

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F3 FAMILY

PSC ENGINEERING INTERFACE FAMILY 3

PSC Manual Lifting Interfaces

Engineering interfaces that improve the coupling between the worker and a manually handled load — replacing improvised hand grips with designed attachment points that reduce pinch exposure, improve load stability, and allow the hand to remain in a controlled position throughout the lift.

1 · ENGINEERING OBJECTIVE

The engineering objective of the Manual Lifting Interface family is not to increase what a worker can lift. It is to **improve the quality of the connection between the worker and the load**.

Many manually handled industrial components are not excessively heavy. They are difficult to grip. They are smooth, oily, cylindrical, or irregular. They offer no designed attachment point. The worker compensates by pinching edges, wrapping fingers around sharp corners, gripping from below, or applying excessive force to maintain control of a surface that was never designed to be held.

The hand is not failing. The interface is missing. Engineering begins by asking: how does the worker connect to this load — and can that connection be designed?

When the coupling between worker and load improves, control improves. When control improves, the conditions that produce pinch, crush, and drop events diminish — not because the worker became more careful, but because the interaction itself was redesigned.

2 · STRUCTURAL REASON THE HAND EXPOSURE EXISTS

Manual handling injuries are frequently attributed to weight or posture. In practice, the more common structural cause is the **absence of a designed grip point**. Three conditions recur across industrial manual handling:

No designed attachment point. Most industrial components — pipes, rollers, valves, cylinders — are not designed with a carry handle. The worker creates a grip using whatever geometry is available: an edge, an end, a flange, a fitting.

Geometry that concentrates load on fingers. Cylindrical components resting on a surface force the worker to slide fingers underneath before the component has left the ground. At that moment, the fingers bear the full weight at the narrowest possible contact zone.

Loss of control during the carry or placement phase. An improvised grip that is adequate for the first few centimetres of a lift may fail as the component shifts its centre of gravity, rotates, or catches unexpectedly — at the moment when the hand is most committed to the hold.

3 · HAND EXPOSURE ADDRESSED

Manual Lifting Interfaces address the following primary exposure mechanisms, which arise directly from the absence of a designed coupling between worker and load:

Fingers Beneath Load

Fingers inserted under a component resting on a surface — the most common retrieve exposure in manual handling.

Pinch at Placement

Hand caught between the component being placed and the receiving surface, rack, or structure.

Grip Failure / Drop

Improvised grip on a smooth or cylindrical surface fails during carry; component drops onto hands or feet.

Edge / Shear Contact

Hand gripping a plate edge, flange, or sharp section profile — the only available grip point on the component.

Rotation Under Grip

Cylindrical component rolls or pivots in the grip; worker's hand absorbs the sudden shift in load distribution.

Overexertion

Excessive grip force required to maintain contact with a smooth, oily, hot, or irregularly shaped surface.

These exposures are structurally produced. They are not corrected by instructing workers to grip more carefully — they are corrected by providing a grip interface that is designed for the task.

F3 Engineering Interface Diagram

"The hand is not failing. The interface is missing."

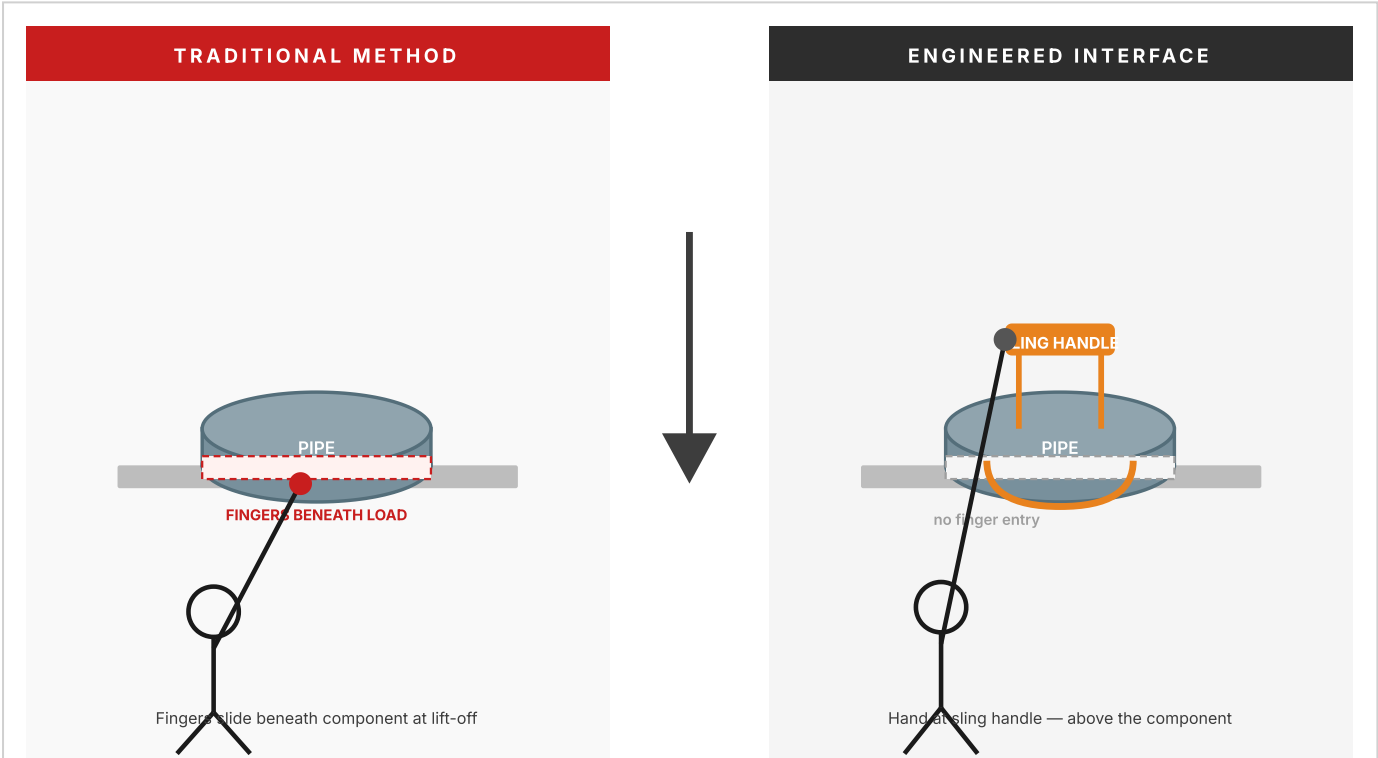


Figure A-F3 — Traditional: fingers slide beneath component at lift-off. Engineered: sling handle lifts from above — fingers never beneath load.

4 · TYPICAL INDUSTRIAL INTERACTIONS

The following interaction types represent the most frequent manual handling situations in which the absence of an engineered coupling creates hand exposure:

INTERACTION TYPE	INDUSTRIAL CONTEXT	WITHOUT INTERFACE
Pipe lifting and carry	Pipe sections moved between storage, fabrication, and installation points across maintenance and shutdown work	Fingers beneath pipe at lift-off; cylindrical surface rotates under grip during carry
Conveyor idler handling	Idler removal and replacement — one of the highest-frequency manual handling tasks in process and steel plants	Both hands grip rotating shell inside conveyor frame; shell may spin or release suddenly under bearing seizure
Roller and shaft carry	Rolling mill, conveyor, and driven roller removal and reinstallation; workshop overhaul and return to service	Workers carry at journal ends; uneven weight distribution causes pivot; hand in bracket zone during seating
Valve and fitting handling	Valve removal and reinstallation during maintenance turnarounds; fitting carry to installation point	Worker grips handwheel — an operating mechanism, not a carry point; valve shifts as bolts are started
Plate and structural section	Steel plate, angle, channel, and flat bar handled in fabrication, structural maintenance, and general construction	Fingers beneath plate at retrieve; edge grip on structural section during carry; heat conduction during welding hold
Small equipment carry	Motors, small pumps, gearbox units, and hydraulic cylinders within the manual handling range	Grip on cooling fins, casing protrusions, or port fittings — none designed as carry surfaces

5 · ENGINEERING AND DESIGN PRINCIPLES

A 15 kg component with an engineered grip interface may be safer and easier to handle than a 5 kg component with none. The kilogram count is not the engineering question. The coupling is.

Improve the Coupling

The interface replaces an improvised grip with a designed attachment. The worker is no longer depending solely on finger strength and friction against a surface not intended for handling. The coupling carries the load; the worker directs it.

Lift From Above, Not Below

The most common retrieve exposure — fingers beneath a component — is eliminated when the interface attaches to the upper surface or passes a sling around the component before it leaves the ground. The hand never enters the space between the component and the surface it rests on.

Match the Interface to the Component Geometry

A cylindrical component requires a different interface than a flat plate. A heavy valve requires a different interface than a length of pipe. Generic solutions serve no geometry well. The interface must be selected or configured for the specific component being handled.

Preserve Load Stability Through the Carry

An improvised grip may hold at lift-off and fail midway through the carry when the component shifts. An engineered interface maintains consistent coupling through the full handling sequence — lift, carry, and placement — without requiring the worker to constantly readjust the grip.

Maintain Neutral Hand Position

Where possible, the interface allows the hand, wrist, and forearm to remain in a natural carry posture. Neutral postures improve control and reduce fatigue across repeated handling cycles — relevant in any operation where components are handled frequently throughout a shift.

Encourage Consistent Method Across Shifts

An interface that provides a clear, repeatable method of attachment reduces variation between workers and across shifts. When the same component is always handled the same way — because the interface defines the grip — the handling method becomes predictable and teachable.

6 · TYPICAL APPLICATIONS

Manual Lifting Interfaces apply wherever components are handled without mechanical assistance and the component geometry offers no designed grip. Applications span steel, process, offshore, fabrication, and general industrial maintenance — the interface principle is not sector-specific.

DEPARTMENT	OPERATION	EXPOSURE WITHOUT INTERFACE	INTERFACE
Hot Strip Mill / Rolling	Conveyor idler replacement and guide roller change-out in mill bays; return roller handling on run-out table	Hands grip rotating idler shell inside frame; fingers in bracket zone during seating	PSC Handle Tech — clamp-on cylindrical grip from above
Mechanical Maintenance	Pipe section, shaft, and hydraulic cylinder carry during planned overhaul and shutdown across all departments	Fingers beneath component at lift-off; cylindrical surface rotates under improvised grip during carry	PSC Lift Assist sling; PSC Ezy Lift for pipe sections
Blast Furnace	Cooling stave pipe handling; taphole drill rod carry; mud gun component change-out during cast house maintenance	Fingers beneath heavy pipes and rods at lift-off in high-temperature cast house environment	PSC Lift Assist sling — designed carry point clear of hot surfaces
Steel Melt Shop	Alloy addition pipe and lance handling; electrode segment carry; ladle slide gate component handling within manual range	Smooth or irregular component surfaces; no designed grip point; fingers beneath component at lift-off in confined bay	PSC Lift Assist sling configured to component geometry
Central Workshop	Small motor, pump body, and gearbox carry during repair and overhaul; valve and fitting handling for service	Grip on cooling fins, flanges, or port fittings — none designed as carry surfaces; grip failure during carry	PSC Lift Assist PSC-CV for motors and valves; PSC-SH-100 for larger components
Structural Maintenance	Pipe section and structural tube carry during steel plant structural repair, equipment base modification, and shutdown construction within the plant	Edge grip on section profile; fingers beneath section at lift; uneven carry distribution on long sections	PSC Lift Assist PSC-DH-100 for two-person carry; PSC Handle Tech for cylindrical sections

APPENDIX A · CONTINUED

F3 · Manual Lifting Interfaces**7 · REPRESENTATIVE PSC ENGINEERING INTERFACES**

The following interfaces represent the PSC and HSF Manual Lifting portfolio. Each addresses a specific coupling problem — sling-based, pipe-end, or cylindrical-surface — rather than attempting a single generic solution across all handling geometries.

PSC Lift Assist Manual Lifting Slings

A range of engineered lifting slings that provide a designed attachment point for manually handled components — replacing improvised grips on pipes, valves, cylinders, fittings, and structural sections with a sling configured before the component leaves the ground.

Primary Engineering Function

Coupling replacement. The sling carries the component's weight; the worker's hands operate the sling handle rather than gripping the component surface. If the component shifts during carry, the sling absorbs the change — the hands are not between the load and the consequence.

Confirmed Variants

PSC-SH-100 — Single Handle, 75 kg WLL · pipes, rollers, shafts, sections (single worker)

PSC-DH-100 — Double Handle, 100 kg WLL · long pipes, long rollers, spools (two workers)

PSC-CV — Choke Valve/Motor Lifter, 50 kg WLL · choke valves, small motors, small pumps

For mechanical lifting operations, separate rigging equipment applies — Lift Assist is manual handling only

PSC Ezy Lift Pipe Lifting Tool

A CNC-machined, rubber-coated tool that inserts into the pipe end to provide a secure, neutral-grip lifting point — eliminating the requirement to slide fingers beneath the pipe at lift-off, which is the primary exposure moment in all pipe retrieve interactions.

Primary Engineering Function

Pipe retrieve and lift without fingers beneath the pipe. The tool is inserted into the pipe bore before the lift begins; the worker lifts from the handle, which is clear of the floor surface throughout. Used as a pair — one worker at each pipe end — for balanced two-person carry.

Design Characteristics

Inserts into pipe bore — grip is from within the pipe, not from beneath it

Rubberised coating provides secure engagement and protects internal pipe surface

Maintains neutral wrist position throughout lift and carry

Designed for use as a set of two — one per pipe end for two-person carry

PSC Handle Tech Cylindrical Surface Handle

A clamp-on handle that locks onto any cylindrical surface — pipes, conveyor idlers, rollers, hoses, bars, and rods — providing an upright carry handle without requiring the worker to grip the cylindrical surface directly or slide fingers beneath the component.

Primary Engineering Function

Grip-from-above for any cylindrical component. The handle clamps to the outer surface; the worker lifts from the handle in a natural standing posture. The grip is always from above — fingers never enter the space beneath the component, regardless of whether the surface is clean, contaminated, hot, cold, or wet.

Design Characteristics

Clamps to cylindrical surface without requiring permanent modification to the component

Suitable for pipes, conveyor idlers, rollers, hoses, and rods — broad cylindrical geometry range

Grip-from-above design eliminates fingers-beneath exposure across all surface conditions

Allows upright carry posture — eliminates hugging, dragging, and body-mass carry methods

HSF LoadGrab® Manual Lifting Slings

The HSF-range equivalent of a designed sling attachment system for manually handled industrial components — providing the same coupling principle as PSC Lift Assist across the full range of component geometries encountered in steel plant and heavy industrial maintenance.

Primary Engineering Function

Coupling replacement for manually handled components within the manual handling range. Not for use in mechanical lifting or rigging operations — the slings are designed exclusively for manual handling tasks where the worker carries the load directly.

Confirmed Variants

HSF-SH-075 — Single Handle, WLL 100 kg · pipes, idlers, rollers, light sections

HSF-DH-100 — Double Handle, WLL 100 kg · long pipes, long rollers, pipe spools

HSF-CV — Choke Valve/Motor Lifter, WLL 50 kg · 2" choke valves, small motors, small pumps

Safety factor 10:1 on all variants; for manual handling only

8 · SELECTION CONSIDERATIONS

Selection of a Manual Lifting Interface begins with the component — its geometry, surface condition, and the specific moment at which the hand exposure occurs. Weight alone is rarely the deciding factor.

Does the component offer a natural grip?

If the component has no designed handle, lifting eye, or grip surface, the worker will improvise one. The selection question is: what interface can replace that improvised grip with a designed one? Start with the component geometry — not with the product catalogue.

Where do fingers enter the hazard?

Map the hand position at the moment of maximum exposure. For most cylindrical components, it is at lift-off — fingers beneath the component before it has left the surface. The interface must prevent that entry. Slings, pipe-end inserts, and clamp handles all achieve this by different routes.

What is the component geometry?

Cylindrical components (pipes, idlers, rollers, hoses) suit pipe-end insert or clamp-on handle interfaces. Flat or irregular components (plates, valves, fittings) suit sling-based coupling. Long components with two workers suit double-handle slings. Match the interface to the geometry, not to the product that is most familiar.

Is the surface clean, contaminated, or at temperature?

An improvised grip on a cold, oily, or muddy surface fails faster than one on a clean surface — but the Handle Tech clamp-on design is unaffected by surface condition. For components at elevated temperature, sling materials and handle composition must be suitable for the thermal environment in which handling occurs.

How frequently is this component handled?

A component handled once per shutdown may tolerate a more involved sling configuration. A conveyor idler replaced multiple times per shift requires an interface that can be applied and removed quickly, without tool use, at the point of work. Frequency of use affects the ergonomic and practical requirements of the interface as much as component weight does.

Is the component within the manual handling range?

Manual Lifting Interfaces are for components within the manual handling range. Where the component exceeds that range, mechanical lifting equipment is required for the primary lift. The Manual Lifting Interface family contributes the coupling and carry interface; it does not extend the weight a worker should manually lift.

ENGINEERING PRINCIPLE — FAMILY 3

"The hand is remarkably adaptable. Engineering should not depend on that adaptability. Where manual handling remains necessary, the interface between the worker and the load should be designed deliberately — rather than improvised at the moment the component needs to move."

Co-author contribution · PSC Engineering Doctrine · Hand Exposure in Integrated Steel Plants, Version 2.0

CONTINUES AT

Appendix A · Family 4 — PSC Striking & Alignment Interfaces

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F4 FAMILY

PSC ENGINEERING INTERFACE FAMILY 4

PSC Striking & Alignment Interfaces

Engineering interfaces that hold, position, and retain chisels, punches, and alignment tools during impact operations — removing the worker's hand from the striking path and eliminating the holding function that conventionally requires the hand to share the hammer's trajectory.

1 · ENGINEERING OBJECTIVE

The engineering objective of the Striking & Alignment Interface family is to **separate the holding function from the striking event**.

In a conventional striking operation, two actions occur simultaneously. The worker holds the chisel, punch, or drift — and another worker strikes it. These two actions are physically linked: the holding hand and the striking hammer occupy the same axis. If the hammer misses, deflects, or the tool shifts at the moment of impact, the consequence is absorbed by the holding hand.

The hand should never share the hammer's path. The engineering objective is to make that separation permanent — not to rely on aim.

A Striking & Alignment Interface holds the chisel, punch, or drift mechanically — freeing the worker's hand entirely from the holding role and removing it from the strike zone. The worker who previously held the tool now operates the interface from a position outside the hammer's trajectory.

2 · STRUCTURAL REASON THE HAND EXPOSURE EXISTS

The exposure in striking operations is structurally built into the conventional method. Three conditions make it persistent:

The tool must be held at the point of impact. A chisel or punch must be positioned precisely and held steady at the moment the hammer strikes. In the absence of a mechanical holder, that function defaults to a hand — positioned directly on the tool, directly in the hammer's path.

Two workers, one axis. Striking operations conventionally require one worker to hold and one to strike. Communication, timing, and aim must all be perfect for every blow. A single error places the holding hand in contact with the hammer head or the deflected tool.

Repetition normalises the exposure. Striking tasks — driving pins, removing keyways, shearing bolts, drifting bearings — are performed thousands of times without incident. That history of near-misses and fortunate aim does not reduce the exposure. It conceals it.

3 · HAND EXPOSURE ADDRESSED

Striking & Alignment Interfaces address the following primary hand exposure mechanisms arising from conventional held-tool striking practice:

Struck-By / Miss-Hit

Hammer strikes the holding hand directly when the blow misses the tool head or the tool shifts at impact.

Tool Deflection

Chisel or punch deflects under impact and contacts the holding hand at speed — often without the striking worker being aware until after the blow.

Vibration / Rebound

Impact energy transmitted through the tool body to the holding hand across repeated blows — producing cumulative exposure even when no individual strike is inaccurate.

Grip Failure at Impact

The holding grip fails at the moment of impact; the tool rotates or shifts and the hand is dragged into the strike path.

Chip / Fragment

Tool or workpiece fragment ejected at impact contacts hand, wrist, or forearm of the holding worker at close range.

Cumulative Percussion

Repeated impact vibration absorbed by the holding hand across a task or shift — leading to soft tissue and nerve exposure without a single identifiable incident.

F4 Engineering Interface Diagram

"The hand should never share the hammer's path."

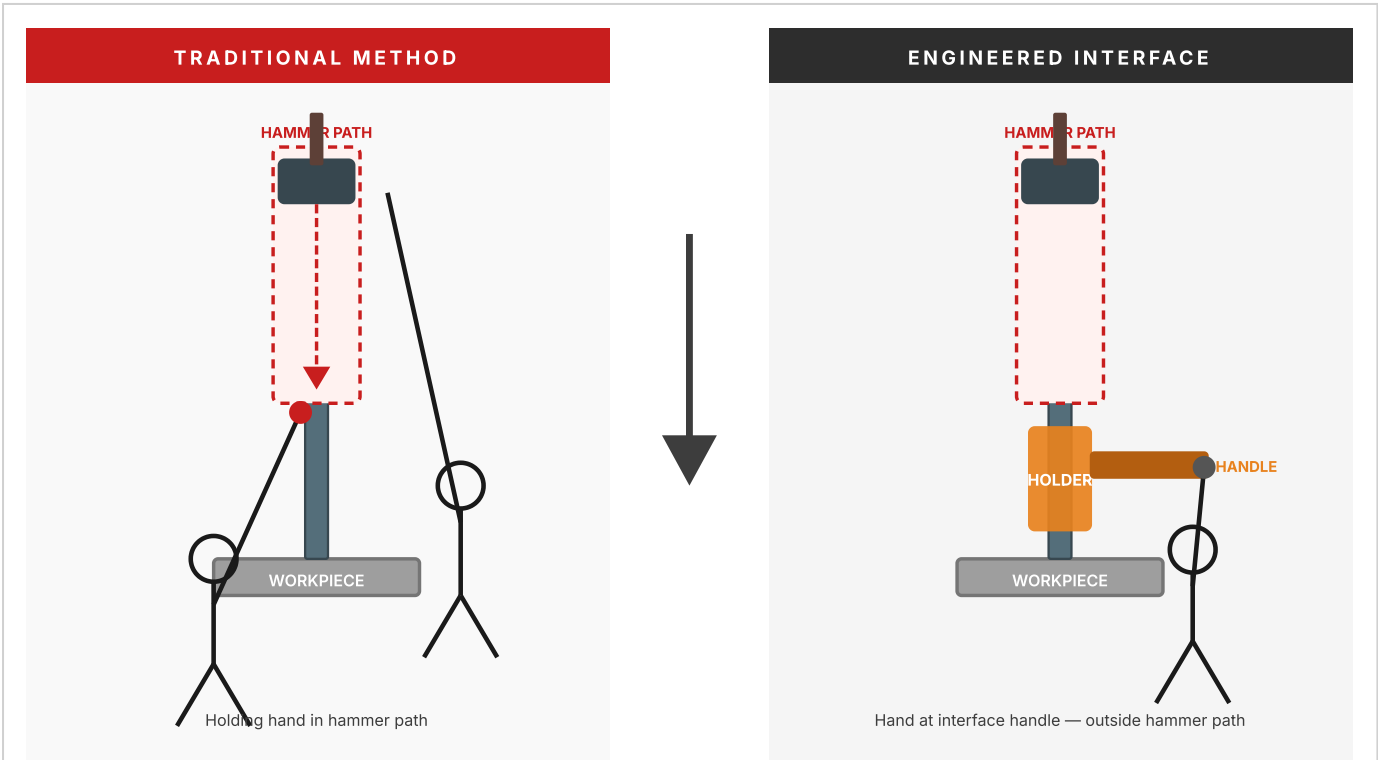


Figure A-F4 — Traditional: holding hand shares hammer path. Engineered: holder removes hand from strike axis entirely.

4 · TYPICAL INDUSTRIAL INTERACTIONS

Striking interactions are among the most widely distributed hand exposure events in industrial maintenance. They occur across every department, every sector, and every skill level — whenever a tool must be held at the point of impact.

INTERACTION TYPE	INDUSTRIAL CONTEXT	WITHOUT INTERFACE
Pin driving and removal	Dowel pins, roll pins, taper pins, and retaining pins driven or extracted during assembly and maintenance across all mechanical departments	One worker holds pin with fingers or drift; second worker strikes — hand shares pin axis throughout
Keyway and key driving	Keys driven into keyways on shafts, couplings, gears, and pulleys during assembly and overhaul work	Key held by hand at shaft entry point; hammer blow required to seat — holding grip in line of strike
Bearing and bush driving	Bearings, bushes, and sleeves driven into housings using drift punches or bearing drivers during mechanical maintenance	Drift held by hand against bearing face; hammer strikes drift head — hand immediately below strike zone
Bolt shearing and removal	Seized or sheared bolts broken out using cold chisels; corroded fasteners removed by chisel and hammer in structural and plant maintenance	Chisel held at fastener with fingers; each hammer blow places holding hand directly in line with the struck surface
Chiselling and material removal	Scale, weld spatter, gasket material, or corroded metal removed by chisel; masonry, concrete, or tile breaking	Chisel gripped close to working end; repeated blows across task duration create cumulative percussion exposure
Structural alignment and drifting	Drift pins used to align bolt holes in structural steel, flanges, and frames before fastening — widespread in fabrication, construction, and steel plant structural maintenance	Drift held by hand in bolt hole; hammer drives it to achieve alignment — both actions occur on the same axis simultaneously

5 · ENGINEERING AND DESIGN PRINCIPLES

In every striking operation, there is a holding force and a striking force. They should never be applied by the same hand — or by any hand at all, once an interface exists to take the holding role.

Remove the Hand from the Strike Zone

The primary engineering objective is physical separation — between the hand and the axis on which the hammer travels. A Striking Interface mechanically holds the tool at the strike point; the worker's hands move to the interface handle, which is positioned outside the hammer's trajectory.

Retain the Tool Under Impact

The interface must hold the chisel or punch securely through the full impact event — including the rebound, the vibration, and any lateral deflection of the tool. A holder that releases the tool under working impact provides no meaningful protection; it simply adds a step before the hand returns to the tool.

Maintain Precise Tool Positioning

Striking tasks require accurate tool placement. A chisel working a bolt head, a punch entering a pin bore, or a drift aligning a bolt hole — all demand positional control that a mechanical holder must maintain as well as a hand. Interface design must provide both retention and precision at the tool tip.

Absorb Vibration at the Interface

The impact energy that conventionally passes through the tool into the holding hand should be absorbed or attenuated at the interface — not transmitted through the handle to the operating worker. Handle design, material selection, and grip geometry all contribute to vibration management at the worker's end of the tool.

Accommodate Tool Geometry Range

Industrial striking tasks use a wide range of tool shank diameters — from light cold chisels to heavy punches and large drift pins. The interface must accommodate the relevant range of shank geometry without requiring the worker to select a different holder for each tool. Adjustable retention is preferable to fixed single-diameter designs.

Enable One-Worker Operation

The conventional two-worker striking method — one holds, one strikes — is itself a risk factor. A Striking Interface that allows a single worker to hold the tool mechanically and strike independently eliminates the communication and timing dependency between two workers operating on the same axis simultaneously.

6 · TYPICAL APPLICATIONS

Striking and alignment interactions occur across every industrial sector wherever mechanical maintenance, fabrication, or construction is performed. The engineering principle applies regardless of sector — what varies is the tool geometry, the component, and the frequency of the interaction.

DEPARTMENT	OPERATION	EXPOSURE WITHOUT INTERFACE	INTERFACE
Mechanical Maintenance	Bearing driving and extraction; key and keyway work on rolls, shafts, and couplings; roll pin driving across all departments	Hand holds drift or punch at shaft and housing — directly in line of hammer throughout operation	PSC-CPH-18 for bearing and heavy drift work; PSC-CPH for standard pin driving
Structural Maintenance	Drift pin alignment of structural connections, grating frames, equipment base plates, and bolted flanged joints	Drift gripped by hand in bolt hole while hammer drives — two workers on same strike axis	PSC FingerSaver™ retains drift; single worker aligns and strikes independently
Hot Strip Mill / Rolling	Roll guide pin and key driving during guide change-out; shear blade retaining pin removal; table roller shaft work	Hand holds punch at roll guide or shear frame — confined mill geometry restricts withdrawal before strike	PSC-CPH holds punch in confined mill geometry; hand clear before each blow
Blast Furnace	Tuyere retaining pin driving; taphole frame bolt shearing; cast house equipment pin and keyway work during reline	Hand on chisel or punch in high-temperature cast house environment; thermal and strike exposure combined	PSC-CPH-18 for heavy cast house pin work; handle provides thermal standoff from struck tool
Coke Oven / Sinter Plant	Door frame and guide pin driving; pusher ram retaining pin removal; pallet wheel and grate bar pin work during shutdown	Drift held by hand during shutdown striking tasks; repeated percussion across full shift duration	PSC FingerSaver™ for standard shank pins; PSC-CPH for heavier drift operations
Central Workshop	Cold chisel work during component refurbishment; weld spatter and scale removal; keyway cutting and dressing on returned shafts	Chisel gripped close to working end for each blow; cumulative percussion across full workshop tasks	PSC FingerSaver™ retains chisel; hand repositioned to handle clear of strike zone

APPENDIX A · CONTINUED

F4 · Striking & Alignment Interfaces**7 · REPRESENTATIVE PSC ENGINEERING INTERFACES**

The PSC Striking & Alignment portfolio addresses the full range of shank diameters encountered in industrial striking tasks — from standard cold chisels to heavy-duty punches requiring a more robust retention system.

PSC FingerSaver™

The PSC FingerSaver™ is engineered to hold chisels, punches, and drift pins mechanically during striking operations — removing the worker's hand from the tool at the moment of impact and placing it on a handle that is clear of the hammer's path.

Primary Engineering Function

Hold-and-strike separation. The FingerSaver™ grips the tool shank securely, maintains precise positioning at the work face, and allows the holding worker to withdraw their hand entirely before the hammer is swung — or eliminates the need for a second holding worker altogether.

Design Characteristics

Holds standard chisel and punch shank diameters encountered in general industrial maintenance

Handle positioned clear of hammer trajectory throughout the striking operation

Retains tool under impact — does not release under working blow or rebound

Compact design suitable for use in confined geometry and restricted access striking tasks

PSC Chisel & Punch Holder (PSC-CPH)

A 6-inch dedicated chisel and punch holding tool providing secure mechanical retention of the tool shank during impact operations — designed for the standard shank diameters and working geometry of industrial chisel and punch tasks.

Primary Engineering Function

Standard-duty mechanical retention for chisel and punch striking. The PSC-CPH holds the tool at the correct presentation angle, retains it through the impact event, and positions the worker's hands on the holder body — outside the strike zone for every blow.

Design Characteristics

6-inch working length — appropriate for standard industrial chisel and punch striking geometry

Accommodates standard shank diameters used across general mechanical and structural striking tasks

Handle position provides secure grip outside the hammer's swing path

Suitable for single-worker operation — eliminates requirement for a second holding worker

PSC Heavy Duty Chisel & Punch Holder (PSC-CPH-18)

An extended, heavy-duty punch and chisel holding tool for larger shank diameters, higher-impact striking tasks, and situations where the standard PSC-CPH working length is insufficient for the access geometry or tool size encountered.

Primary Engineering Function

Heavy-duty mechanical retention for high-impact striking operations. The PSC-CPH-18 provides the same hand-removal engineering as the standard holder — applied to the heavier punches, larger drifts, and higher-energy striking tasks found in bearing driving, structural alignment, and heavy mechanical maintenance.

Design Characteristics

Extended working length for larger tool shank diameters and higher-energy impact operations

Heavy-duty construction maintains retention integrity under heavier hammer blows and larger tool rebound

Suitable for bearing drivers, large drift pins, heavy cold chisels, and structural alignment punches

Increased standoff between worker's hands and strike point relative to the standard PSC-CPH

Engineering Note — Tool Selection by Task

Selecting the correct Striking Interface requires matching the holder to the tool shank diameter, the impact energy of the operation, and the access geometry of the task location. A holder that fits the tool but cannot be positioned correctly in the working space provides incomplete protection.

Selection Framework

Match tool shank diameter to holder retention geometry. Confirm the holder handle is accessible from outside the hammer swing path in the working position. Assess whether single-worker or two-worker operation is required. Confirm the holder retains the tool at the required presentation angle for the specific striking task.

When to Step Up to PSC-CPH-18

Tool shank diameter exceeds the PSC-CPH retention range

Impact energy is high enough that standard holder retention may be insufficient

Working geometry requires greater standoff between hand and strike point

Task involves heavy bearing driving, large drift alignment, or structural pin operations

8 · SELECTION CONSIDERATIONS

Striking Interface selection is governed by four variables: the tool being held, the impact energy of the operation, the geometry of the working space, and the method of working — single or two-person. Each determines a different requirement from the holding interface.

What tool is being held?

Shank diameter is the primary matching criterion. The holder must grip the tool securely across its retention geometry — a holder that grips too loosely will allow the tool to shift at impact; one with too narrow a retention slot will not accept the tool. Confirm shank diameter before selecting the holder.

What is the impact energy?

Light chisel work — removing weld spatter, gasket material, or surface scale — requires different retention from heavy bearing driving or structural drift work. The PSC-CPH is suited to standard-duty impact; the PSC-CPH-18 provides the robustness required for heavier operations where rebound and lateral forces are greater.

What is the working geometry?

Assess where the holder handle will be positioned relative to the hammer swing. In confined spaces — inside housings, in structural connections, or in tight deck geometry — the available swing arc and holder handle clearance must be confirmed before the operation begins. A holder that cannot be positioned correctly provides no benefit.

Single or two-worker operation?

The conventional two-worker method can be replaced with single-worker operation once a mechanical holder is in use. This eliminates the communication and timing dependency between holding and striking workers — and removes a second person from the strike zone entirely. Assess whether the task allows the worker to strike independently once the tool is held mechanically.

What is the presentation angle required?

Some striking tasks require the tool to be presented at a specific angle — at a shallow angle to a surface for chiselling, perpendicular to a flange face for drift alignment, or at a defined entry angle for a pin bore. The holder must maintain the tool at the required presentation angle under the lateral forces of repeated impact without requiring manual correction between blows.

Is the task repetitive?

A striking task performed once per shift may tolerate a standard holding method if full hand removal is achieved. A task performed dozens of times per shift across many years — scale removal, bolt shearing, repeated pin driving — accumulates both acute impact risk and cumulative percussion exposure. The engineering priority increases proportionally with task frequency and duration.

ENGINEERING PRINCIPLE — FAMILY 4

"The hand should never share the hammer's path. Every missed blow in a striking operation is preceded by a successful one — and the only difference between them is timing. Engineering the hand out of the strike zone removes timing from the equation entirely."

PSC Engineering Doctrine · Hand Exposure in Integrated Steel Plants, Version 2.0

CONTINUES AT

Appendix A · Family 5 — PSC Magnetic Handling Interfaces

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F5 FAMILY

PSC ENGINEERING INTERFACE FAMILY 5

PSC Magnetic Handling Interfaces

Engineering interfaces that attach to the upper surface of ferrous components — enabling retrieval, lifting, and positional control from above, without fingers entering the space between the component and the surface it rests on.

1 · ENGINEERING OBJECTIVE

The engineering objective of the Magnetic Handling Interface family is to **eliminate the retrieve exposure — the moment when a worker's fingers slide beneath a ferrous component to establish the grip that will lift it from the surface.**

Most ferrous components resting on a surface present the same fundamental problem: there is no clearance beneath them. The only available grip is from below. The worker tilts one edge upward, slides fingers into the gap, and lifts — placing the fingers between the full weight of the component and the floor at the moment of maximum loading.

Retrieve from above — not from underneath. A magnet applied to the upper face of a component eliminates the retrieve exposure entirely. The hand never enters the space below.

Magnetic Handling Interfaces resolve this by reversing the direction of attachment. Instead of gripping from below, the interface attaches to the top face of the component. The worker lifts from the handle — which is above the component — and fingers never enter the gap between the component and the surface beneath it.

The same magnetic attachment principle also applies to guidance and control interactions on ferrous surfaces — where a conventional push tool may slide off a curved or contaminated surface, a magnetic interface maintains positive contact throughout the positioning action.

2 · STRUCTURAL REASON THE HAND EXPOSURE EXISTS

The retrieve exposure is structurally determined by three conditions that recur across every ferrous component handling task:

- **No clearance beneath the component.** A steel plate, grating, or machined component resting flat on a surface offers no finger entry beneath it. The worker must first create clearance — by tilting the component — before the grip can be established. That tilt places the fingers in the gap at the moment when the component is most likely to rock back.
- **No designed lift point on the upper face.** Most ferrous maintenance components — plates, gratings, slugs, machined parts — have no lifting eye, no handle, and no recessed grip on their upper surface. The absence of a designed attachment point from above forces the grip to come from below.
- **Weight uncertainty at lift-off.** A component that appears light may retain process fluid, embedded debris, or have seized on a corroded surface. The improvised grip established at lift-off — fingers beneath the component — must absorb whatever weight is actually encountered when the component begins to move.

3 · HAND EXPOSURE ADDRESSED

Fingers Beneath Load

Primary retrieve exposure — fingers in gap between component and floor at the moment of full weight transfer.

Component Rock-Back

Tilted component rocks back flat before grip is secure — fingers compressed between component face and surface.

Grip Failure / Drop

Improvised under-grip on smooth ferrous surface fails during carry — component drops onto hands or feet.

Sudden Release

Component seized on corroded surface releases suddenly at lift-off — hands accelerate with the component.

Slip on Curved Surface

Push tool slides off curved or contaminated ferrous surface during guidance — sudden loss of contact and hand displacement.

Cumulative Retrieve

High-frequency grating or plate retrieval — individual risk low, cumulative exposure across a shift significant.

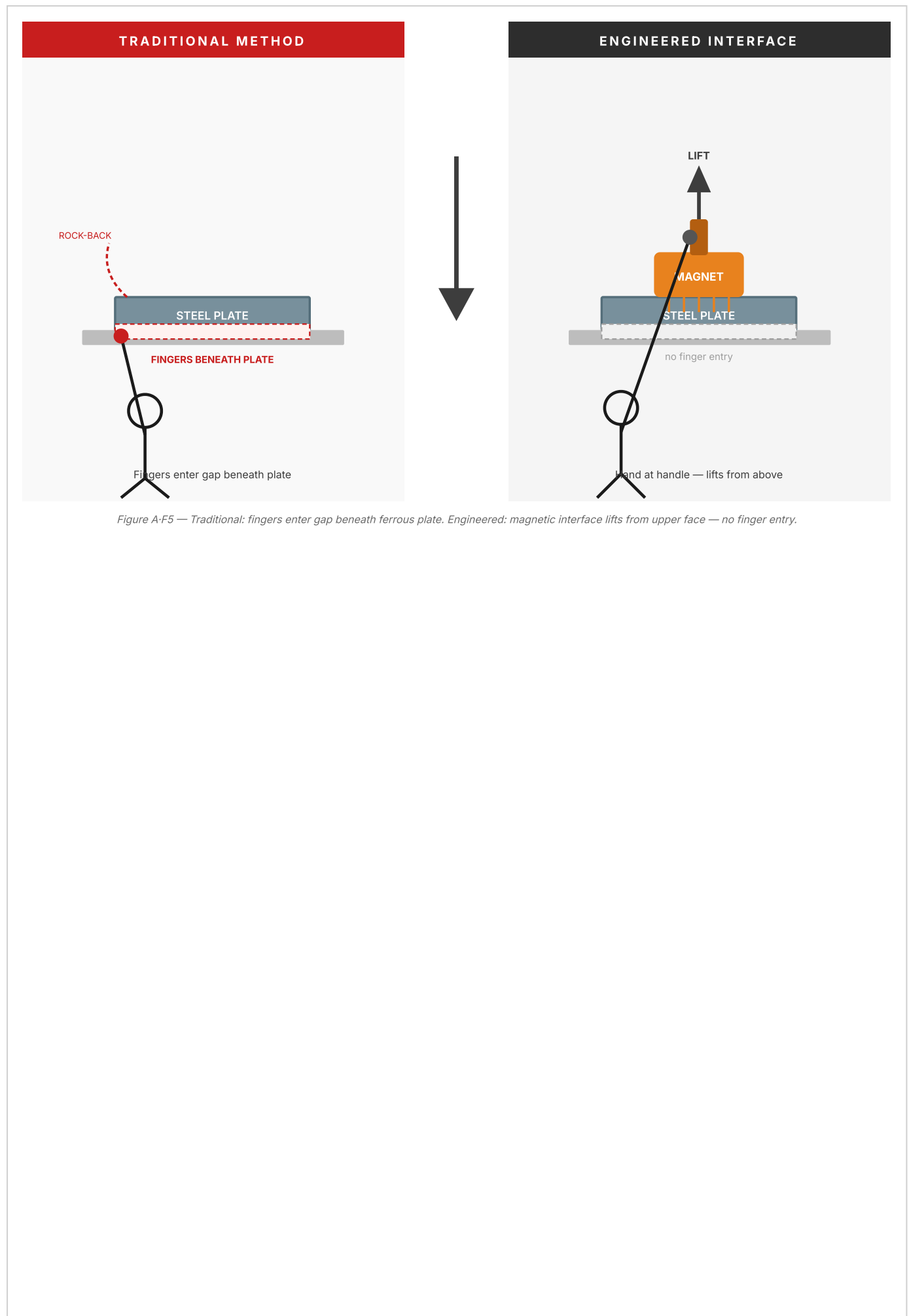
F5 Engineering Interface Diagram*"Retrieve from above — not from underneath."*

Figure A:F5 — Traditional: fingers enter gap beneath ferrous plate. Engineered: magnetic interface lifts from upper face — no finger entry.

4 · TYPICAL INDUSTRIAL INTERACTIONS

Magnetic Handling Interfaces address two distinct classes of interaction — retrieve and lift from above, and guidance and control on ferrous surfaces. Both arise from the same fundamental property of the magnetic attachment: it acts on the upper surface, reversing the direction from which the worker engages the component.

INTERACTION TYPE	INDUSTRIAL CONTEXT	WITHOUT INTERFACE
Steel plate retrieve and lift	Plate lifted from floor, rack, or stack — fabrication, structural maintenance, plate mill, and general construction	Worker tilts one edge, slides fingers beneath, lifts from below — fingers in compression zone at full plate weight
Grating removal and replacement	Steel gratings removed and replaced during access maintenance, inspection, and platform modification — often repeated many times per shift	Fingers inserted through grating mesh to grip from within — confined geometry with full grating weight on finger contact zone
Machined component retrieval	Slugs, discs, covers, and machined parts retrieved from benches, floors, and racks in workshops and maintenance bays	Smooth machined surface offers no grip from above; fingers slide beneath on flat surface with no clearance
Ferrous component positioning	Motor casings, gearbox housings, plates, and structural sections guided during crane positioning or manual placement	Push tool slides off curved or contaminated ferrous surface; hand repositions to regain contact — in load movement zone
Road plate and trench plate	Heavy steel road and trench cover plates removed and replaced during civil and utility maintenance — high weight, smooth surface, no grip	Bar used to lift edge; fingers beneath plate before crane or lifting equipment can engage — crush zone active
Small ferrous item recovery	Shim packs, thin sheet metal offcuts, freshly cut plate, and small ferrous parts recovered from surfaces in fabrication and maintenance	Pinch grip on thin edge or smooth face — fingers in shear zone if item slides or drops

5 · ENGINEERING AND DESIGN PRINCIPLES

Retrieval is different from lifting. Lifting begins once a grip exists. Retrieval is the moment before — when the fingers must enter the gap to create that grip. That is the exposure. Magnetic attachment eliminates it by making the gap unnecessary.

Attach from Above

Magnetic attachment to the upper face of the component reverses the direction of engagement. The interface requires no clearance beneath the component and no finger entry into the gap at the floor surface. The lift begins from a position of contact — not from a position of finger insertion.

Holding Force Must Exceed Working Load

The magnetic holding force must reliably exceed the weight of the component under the expected surface conditions. Painted, corroded, uneven, or thermally affected surfaces reduce effective magnetic holding force below nominal ratings. Model selection must account for actual surface condition — not only component weight.

Controlled Engagement and Release

A magnetic lifter that attaches and releases predictably is an engineering tool. One that releases unexpectedly during carry, or cannot be released cleanly at placement, creates its own hazard. Lever-engage, switch-magnet, and locking-pin designs each offer different engagement and release characteristics suited to different task frequencies and working environments.

Approach Geometry for Confined Access

Components in racks, inside housings, or in recessed locations cannot always be approached vertically. Magnetic interfaces with articulating heads — rotating and pivoting at the attachment point — allow engagement from angles that a fixed-head lifter cannot achieve, extending the range of confined-access retrieve interactions the tool can address.

Positive Contact for Guidance Tasks

When used for ferrous load guidance and control — rather than lift and retrieve — the magnetic interface must maintain positive, slip-resistant contact throughout the positioning action. A MagHead tool attached magnetically to a ferrous surface does not lose contact when the approach angle changes or the surface is curved, contaminated, or at temperature.

Cumulative Benefit at High Frequency

The engineering value of a magnetic interface is compounded by task frequency. A single grating retrieval that eliminates one set of fingers-through-mesh exposure is a single improvement. The same elimination applied across every retrieval in a shift — dozens of operations — produces a substantially different cumulative exposure profile for the worker performing that task daily.

6 · TYPICAL APPLICATIONS

Magnetic Handling Interfaces apply wherever ferrous components must be retrieved, lifted, or guided — and where the absence of a designed grip point from above forces the worker to engage from below. The engineering principle is identical across sectors; only the component weight, surface condition, and access geometry vary.

DEPARTMENT	OPERATION	EXPOSURE WITHOUT INTERFACE	INTERFACE
Structural Maintenance	Steel grating removal and replacement during inspection access, platform maintenance, and structural repair across all plant areas	Fingers inserted through grating mesh to grip from within — full grating weight on finger contact zone at lift-off	HSF-MG004 / HSF-MG005 — magnetic retrieve from grating upper face
Plate Mill / Structural	Steel plate retrieval from transfer car floors, inspection table surfaces, and storage stacks; plate pack separation during bundling	Worker tilts plate edge, slides fingers beneath, lifts from below — fingers in compression zone at full plate weight	HSF-MG004 / HSF-MG005 — lift from upper face; fingers never beneath plate
Mechanical Maintenance	Motor and gearbox ferrous casing guidance during crane-assisted installation; ferrous component positioning onto base plates and mounting frames	Push tool slides off curved or contaminated casing surface; hand repositions against moving component during positioning	PSC Load-it MagHead — magnetic contact guidance on ferrous casing surfaces
Central Workshop	Machined component and slug retrieval from workshop benches and floors; shim pack and thin ferrous plate recovery during overhaul	Smooth machined surface offers no grip from above; fingers slid beneath component with no clearance on flat bench surface	HSF-LG-MHL for small components; HSF-LG-001 for confined rack and housing retrieval
Hot Strip Mill / Rolling	Ferrous guide component and wear insert retrieval from mill housing surfaces; roll gap shim and packer recovery during roll change	Thin ferrous components flat on mill housing surface — no clearance beneath; improvised pinch grip on smooth face	HSF-LG-MHL for thin shims and small inserts; HSF-LG-001 for confined housing retrieval
Steel Melt Shop	Ferrous ladle component and alloy chute plate handling during SMS maintenance; slide gate frame and cover retrieval	Heavy ferrous components on flat furnace bay floor — no clearance, no grip point from above; fingers beneath in high-temperature environment	HSF-MG004 — lever-engage lifter for controlled retrieve in high-temperature SMS environment

APPENDIX A · CONTINUED

F5 · Magnetic Handling Interfaces**7 · REPRESENTATIVE PSC AND HSF ENGINEERING INTERFACES**

The PSC and HSF Magnetic Handling portfolio spans from compact hand tools for light ferrous components to full-capacity lifters for steel plate and grating — and includes MagHead push/pull tools for ferrous surface guidance during mechanical positioning.

PSC Load-it MagHead Extendable Push/Pull Tool

A telescopic push/pull pole with magnetic head for positive-contact guidance and control of ferrous loads — providing slip-resistant directional force on curved, contaminated, or irregular ferrous surfaces where a conventional push pad cannot maintain reliable contact.

Primary Engineering Function

Magnetic-contact positioning and guidance. The MagHead attaches to the ferrous surface and maintains contact throughout the directional force application — keeping the worker's hands at pole length from the load surface during guidance, alignment, and control interactions on ferrous components.

Design Characteristics

Magnetic head provides positive, slip-resistant attachment to ferrous surfaces

Extendable shaft increases standoff for elevated, confined-bay, and crane-assisted positioning tasks

Suitable for motor casings, gearbox housings, steel plates, and structural ferrous components

Bridges the gap between close-range magnetic contact and full suspended load separation

HSF LoadGrab® Magnetic Hand Lifter (HSF-LG-MHL)

A compact switch-magnet hand tool for retrieving and lifting small ferrous components — thin sheet metal, freshly cut plate, machined parts, and small ferrous items — from surfaces where finger-beneath access would otherwise be the only available grip method.

Primary Engineering Function

Small ferrous component retrieve from above. The 2-inch diameter magnetic base attaches to the upper face of the component; the switch disengages cleanly at the placement point. Suitable for confined locations and frequent small-component handling tasks where a larger lifter would be impractical.

Design Characteristics

Compact 2-inch magnetic base — access in confined locations not reachable by larger lifters

Switch magnet for fast, clean engagement and release across high-frequency tasks

Suitable for thin sheet metal, freshly cut or heated plate, and small machined ferrous parts

Nominal capacity 65 lbs per magnet — confirm surface condition before use

HSF LoadGrab® MagHead Lifter (HSF-LG-001)

A handheld magnetic lifter with 360° rotation and 180° pivot articulation — enabling engagement from any approach angle, including confined rack locations, recessed housings, and positions where a fixed-head lifter cannot achieve contact with the component face.

Primary Engineering Function

Articulated retrieve from confined and restricted locations. The multi-axis articulation allows the magnetic face to be presented to the component regardless of approach geometry — extending the retrieve capability to components in racks, inside machine housings, and in locations where vertical approach is not available.

Design Characteristics

360° rotation and 180° pivot — engagement from any approach angle

3-function locking pin for secure attachment confirmation before lift

Also functions as a pull tool for horizontal movement of ferrous components

Nominal capacity 550 lbs (250 kg) — confirm surface condition and contact area before use

HSF LoadGrab® Magnetic Lifters IV & V (HSF-MG004 / HSF-MG005)

Full-capacity magnetic lifters for steel plate retrieve, grating removal, and medium-to-heavy ferrous component handling — differing in their engagement mechanism to suit different task frequency and working method requirements.

Primary Engineering Function

Steel plate and grating retrieve and lift from above. Both models eliminate fingers-beneath exposure across the full weight range of manually handled ferrous plate and grating. Model selection is based on engagement frequency and working method — lever for controlled individual lifts; switch for high-frequency operations where cycle time matters.

Model Differentiation

HSF-MG004 (Lifter IV) — Manual lever engage/disengage; D-Handle; for controlled plate and grating lift

HSF-MG005 (Lifter V) — Switch magnet; V-Handle; for high-frequency plate and grating tasks

Both: nominal capacity 550 lbs (250 kg); heavy-duty alloy steel construction

8 · SELECTION CONSIDERATIONS

Magnetic Interface selection involves four variables that are independent of component weight: the surface condition of the component, the approach geometry of the task, the required engagement mechanism, and whether the interaction is a retrieve/lift or a guidance/control task. Each changes the selection.

Is the component ferrous?

Magnetic Handling Interfaces are limited to ferrous components. Non-ferrous materials — aluminium, stainless steel in some grades, copper alloys, plastics — do not respond to permanent magnet attachment. For non-ferrous components within the manual handling range, sling-based Manual Lifting Interfaces (Family 3) apply.

What is the surface condition?

Nominal magnetic capacity ratings assume clean, flat, uncoated ferrous surfaces. Paint, corrosion, scale, uneven surface texture, and thermal effects all reduce effective holding force below the nominal rating. Always assess actual surface condition — not just component weight — before confirming that a selected model provides adequate holding force for the specific component.

What is the approach geometry?

Can the component upper face be approached vertically with a fixed-head lifter? Or does the location — a rack, a housing, a recessed floor socket — require an angled approach? Where vertical access is unavailable, an articulating magnetic head (HSF-LG-001) is required. Fixed-head lifters cannot be forced to engage at angles that compromise the contact area and therefore the holding force.

Lift/retrieve or guidance/control?

Magnetic Lifters (HSF-LG-MHL, HSF-LG-001, HSF-MG004, HSF-MG005) are designed for retrieve and lift interactions — vertical force application on a component to be raised. MagHead Push/Pull Tools (PSC Load-it MagHead, HSF MagHead range) are designed for lateral guidance and control — horizontal or angled force on a ferrous surface during positioning. These are distinct tools for distinct interactions.

What is the task frequency?

For low-frequency retrieval, a lever-engage lifter (HSF-MG004) provides the most controlled engagement and release. For high-frequency tasks — grating removal multiple times per shift — a switch-magnet lifter (HSF-MG005 or HSF-LG-MHL) reduces cycle time significantly. The cumulative hand exposure reduction across many repeated operations is a primary engineering justification for the higher-frequency model in repetitive tasks.

What is the component weight relative to capacity?

Select a model whose nominal capacity provides a comfortable margin above the actual component weight — accounting for surface condition derating. A component at the top of a lifter's nominal capacity on an ideal surface may exceed that capacity on a painted or corroded surface encountered during routine maintenance. Margin matters more than matching the nominal rating exactly.

APPENDIX A · CONTINUED

F5 · Selection Considerations

ENGINEERING PRINCIPLE — FAMILY 5

"Retrieve from above — not from underneath. The retrieve exposure exists because the grip must come from below. A magnetic interface eliminates that requirement entirely. The gap between the component and the floor becomes irrelevant — because the hand never needs to enter it."

PSC Engineering Doctrine · Hand Exposure in Integrated Steel Plants, Version 2.0

CONTINUES AT

Appendix A · Family 6 — PSC Specialised Maintenance Interfaces

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F6 FAMILY

PSC ENGINEERING INTERFACE FAMILY 6

PSC Specialised Maintenance Interfaces

Engineering interfaces developed for recurring maintenance interactions that do not fit within the five primary interface families — task-specific solutions for object geometries, access conditions, or operating environments where general-purpose tools still leave the hand in contact with the hazard.

1 · ENGINEERING OBJECTIVE

The engineering objective of the Specialised Maintenance Interface family is to develop **task-specific engineered solutions for recurring interactions where the five primary interface families do not provide an adequate fit.**

The five preceding families address the most common classes of hand exposure in industrial maintenance. But industrial work is not reducible to five categories. Certain tasks occur frequently, involve consistent hand exposure, and yet present a combination of object geometry, access constraint, or operating condition that no general-purpose interface addresses cleanly.

In the absence of a purpose-designed solution, workers improvise. They adapt available tools to tasks those tools were not designed for. They develop workarounds that become accepted practice. They repeat an unsafe method hundreds of times until it no longer registers as unsafe. Repeated improvisation is evidence that an engineered interface is needed. The workaround is not a solution — it is an unresolved engineering problem.

Specialised Maintenance Interfaces are developed by observing those recurring improvisations and asking the engineering question: can this interaction be redesigned? In most cases, it can. The object is specific. The task is consistent. The exposure is structural. Those three conditions make a purpose-designed interface both practical and justified.

2 · STRUCTURAL REASON THE HAND EXPOSURE EXISTS

Specialised maintenance exposures share a common structural characteristic: **the object itself does not accommodate a safe conventional grip, and no standard tool bridges the gap.**

- **Object geometry that defeats standard grips.** A gas cylinder is heavy, cylindrical, pressurised, and smooth. Its valve is not a carry point. Its body offers no grip surface. The worker wraps arms or hands around it — a technique that is simultaneously the only available method and a consistent source of crush, drop, and impact exposure.
- **Access constraints that exclude standard tools.** Components inside machine housings, behind guarding, or in recessed locations cannot be reached by a standard push/pull tool or hook. The worker reaches in by hand — because nothing else fits.
- **Frequency that normalises the exposure.** These tasks are performed often. A worker who has moved gas cylinders by hand every day for five years does not perceive it as a hazardous interaction. That familiarity is not safety. It is repeated exposure, uninterrupted.

3 · HAND EXPOSURE ADDRESSED

Crush / Drop

Gas cylinder dropped or toppled during manual repositioning — hands and feet in contact zone throughout.

Pinch / Impact

Hands caught between cylinder body and fixed structure during movement; cylinder contacts hand on sudden tip.

Confined Reach

Hand inserted into restricted geometry to retrieve, reposition, or engage a component with no external reach solution.

Improvised Tool Use

Modified or incorrect tool applied to the interaction — exposing the hand to slip, release, or unintended contact at the work face.

Loss of Control

Inadequate grip on a heavy, smooth, or awkward object — load shifts unexpectedly during carry, placement, or repositioning.

Repetition Exposure

Low individual risk multiplied by high task frequency — cumulative exposure across shift and career duration.

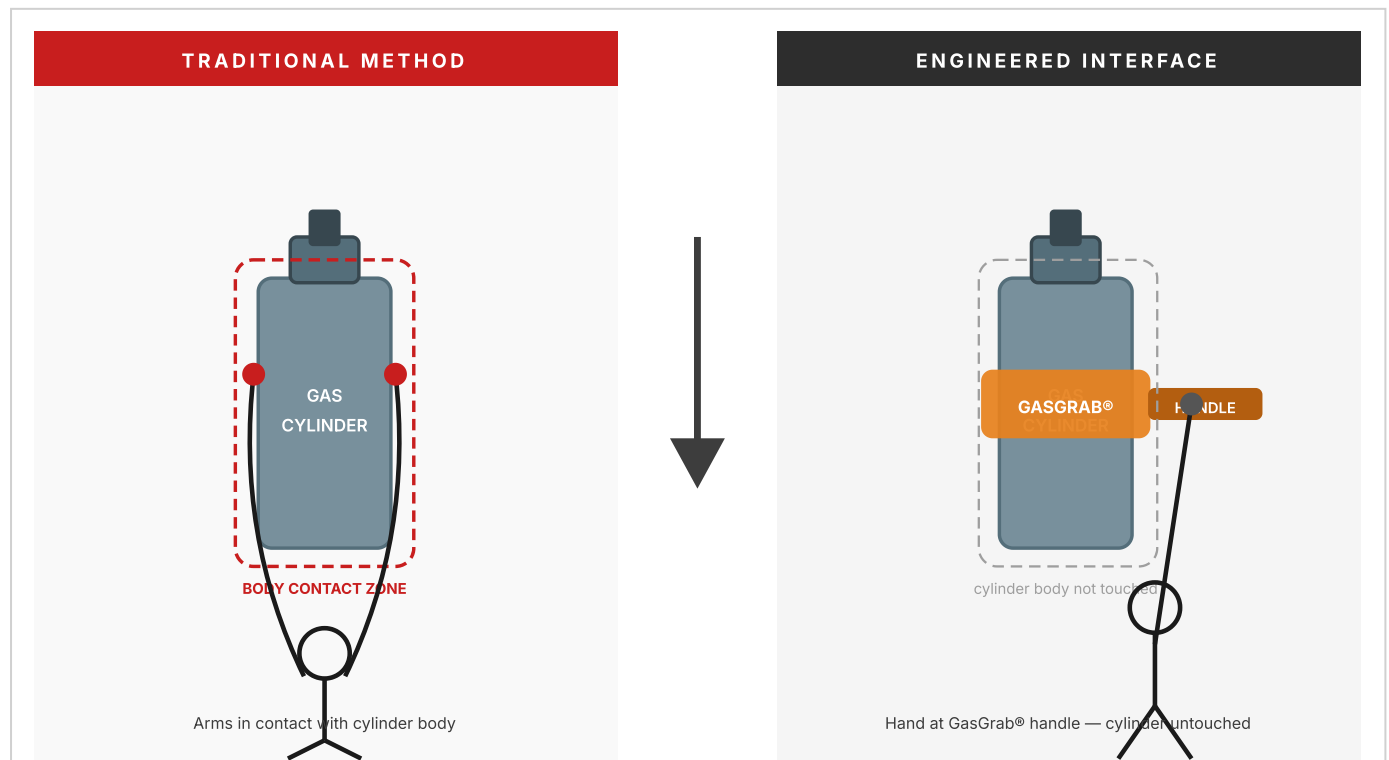
F6 Engineering Interface Diagram*"Repeated improvisation is evidence that an engineered interface is needed."*

Figure A-F6 — Traditional: arms in contact with cylinder body. Engineered: GasGrab® handle separates hand from cylinder throughout carry.

4 · ENGINEERING AND DESIGN PRINCIPLES

Although each Specialised Maintenance Interface addresses a different task, they share a common engineering logic. The principles below apply across the family:

Task-Specific Design

The interface is developed around one clearly defined interaction — not a range of possible applications. A gas cylinder interface is designed for gas cylinders. A confined-access hook tool is designed for the specific access geometry it must navigate. Specificity is what makes the interface effective where a general-purpose tool fails.

Replace Improvisation with Repeatability

The improvised workaround varies between workers and shifts. The engineered interface performs the same interaction the same way every time. Repeatability is itself a safety outcome — a consistent method is teachable, auditable, and improvable. An improvised method is none of those things.

Maintain Separation

Where the task involves a hazardous object — pressurised, heavy, hot, or electrically live — the interface increases the separation between the worker's hands and the hazard surface. The degree of separation required is determined by the consequence of contact, not only by the probability of it.

Preserve Control

An interface that increases separation at the cost of control is not an improvement — it is a different hazard. Specialised interfaces must maintain the worker's ability to perform the task accurately and predictably. A gas cylinder handle that provides a secure grip is only useful if it also allows the cylinder to be manoeuvred precisely to where it needs to go.

5 · TYPICAL INDUSTRIAL INTERACTIONS

The following interactions represent the task categories addressed by Specialised Maintenance Interfaces within the steel plant environment. Each row maps directly to one of the two representative interfaces in this family.

DEPARTMENT	INTERACTION	EXPOSURE WITHOUT INTERFACE	INTERFACE
Central Workshop	Gas cylinder movement and repositioning during welding, cutting, and fabrication operations — the most frequent cylinder handling context in any steel plant workshop	Hands and arms wrapped around smooth cylinder body; hands in contact zone if cylinder tips or drops	PSC GasGrab® — purpose-designed cylinder carry handle
Mechanical Maintenance	Gas cylinder repositioning at point of use during maintenance welding and gas cutting operations across plant departments during shutdown	Cylinder tilted and walked on its base rim — hands on valve end or cylinder body throughout; impact and crush exposure if balance lost	PSC GasGrab® — secure grip from handle; hands clear of cylinder body
Structural Maintenance	Retrieving dropped or dislodged hardware — bolts, pins, wedges, shims — from structural recesses, beam flanges, and frame cavities during steel plant structural work	Hand inserted into structural recess or cavity to retrieve component by feel; limited visibility; hand in confined geometry with edges and pinch points	PSC Grappler® — hook retrieval without hand entry into cavity
Hot Strip Mill / Rolling	Snagging and repositioning rigging, slings, and chain in confined mill bay geometry during roll change and equipment change-out — where suspended rigging settles beyond direct hand reach	Worker reaches into confined bay geometry by hand to reposition rigging; proximity to suspended load and moving equipment	PSC Grappler® — hook, snag, and reposition rigging from safe standoff
Blast Furnace	Gas cylinder handling for cast house maintenance welding and gas cutting operations in high-temperature, congested cast house environment	Cylinder carried by hand grip on body in congested, thermally challenging environment; collision and drop risk compounded by working conditions	PSC GasGrab® — controlled carry; hands separated from cylinder body throughout
Steel Melt Shop	Retrieving and repositioning components, tools, and hardware that have fallen into recessed locations within the SMS bay floor, equipment pits, or behind furnace structures	Hand reaches into restricted geometry in high-temperature furnace bay environment — limited visibility, high edge and pinch exposure	PSC Grappler® — reach and retrieve without hand entry into recess

6 · REPRESENTATIVE PSC ENGINEERING INTERFACES

The two interfaces below represent the current Specialised Maintenance portfolio available through PSC. Each addresses a defined recurring interaction where no standard interface family provides an adequate solution.

PSC GasGrab® Gas Cylinder Handling Interface

A purpose-engineered handle that attaches to a gas cylinder body, providing a secure ergonomic grip for lifting and repositioning — eliminating the requirement to wrap hands or arms around the cylinder during manual movement.

Primary Engineering Function

Replace body-contact cylinder carry with a designed handle interface. The GasGrab® attaches to the cylinder body; the worker lifts and manoeuvres from the handle rather than gripping the smooth cylinder surface directly. Hands are separated from the cylinder body — the primary contact and crush zone — throughout the carry and placement interaction.

Confirmed Design Characteristics

Die-cast aluminium construction with rubber lining — lightweight (under 2 kg), rigid, and durable

Warm-touch coating for operator comfort and safe handling in industrial environments

Rubber lining provides secure grip on cylinder body without damaging the cylinder surface

Available in five sizes: 215 mm, 230 mm, 235 mm, 254 mm, 267 mm — to fit standard cylinder diameters

GasGrab™ is a product of Arrow (Newbury) Ltd, distributed in India by PSC

PSC Grappler® No-Touch Hook Tool

A lightweight hook tool for grabbing, snagging, hooking, pulling, and pushing objects in locations beyond normal reach or in confined geometry — eliminating the need to insert a hand into a restricted space or extend a bare arm toward a suspended or inaccessible component.

Primary Engineering Function

Reach, retrieve, and reposition without hand entry into the hazard geometry. The Grappler® engages rigging, chain, slings, hardware, and components from the proximal handle end — the worker's hands remain at the handle while the hook performs the interaction at the distal tip. Available in three lengths to match the standoff required by the specific access geometry.

Confirmed Design Characteristics

5052 laser-cut hook — designed to grab, snag, hook, pull, and push without hand contact at engagement point

Non-slip, abrasion-resistant straight handle — secure grip under industrial working conditions

Three stock lengths: 18" (GRA001-18, 0.5 lbs), 26" (GRA001-26, 0.75 lbs), 34" (GRA001-34, 1 lb)

High-visibility bright yellow/green — tool remains visible in congested maintenance environments

Custom lengths available — suitable where standard lengths do not match the access geometry

Grappler® is a product of Adamar Industries LLC (U.S. Patent No. 9,975,254), distributed by PSC

APPENDIX A · CONTINUED

F6 · Specialised Maintenance Interfaces

7 · SELECTION CONSIDERATIONS

Is the task recurring?

A one-time improvised solution may be acceptable for a non-recurring task. A Specialised Interface is justified when the same interaction occurs repeatedly — daily, weekly, or at every shutdown. The engineering investment in a purpose-designed tool is proportional to the frequency at which the exposure it eliminates is encountered.

GasGrab® — cylinder diameter match

Select the GasGrab® size that matches the external diameter of the cylinder being handled. Five sizes span the range of standard industrial gas cylinders in common steel plant use. A size that does not match the cylinder diameter will not provide secure attachment — the rubber lining must contact the cylinder body consistently around the grip circumference.

Grappler® — length selection

Select the Grappler® length based on the standoff required to keep the worker's hands outside the hazard zone at the point of hook engagement. The 18" length suits close-range retrieval from shallow recesses. The 26" and 34" lengths suit deeper confined geometry, structural cavities, and rigging repositioning in mill bay or furnace bay environments where the snagging point is further from the worker's reach position.

Is the current method improvised?

If the worker is using a modified tool, an incorrect tool, or bare hands to perform a recurring task — that is the signal. Repeated improvisation confirms that the task presents a consistent interaction requirement that existing tool families do not address. Observe the improvisation, identify the interaction it is performing, and ask whether a purpose-designed interface can perform the same interaction with reduced hand exposure.

ENGINEERING PRINCIPLE — FAMILY 6

"Repeated improvisation is evidence that an engineered interface is needed. When workers consistently adapt the same tool, or reach into the same space, or grip the same object in the same unsafe way — they are not being careless. They are solving an engineering problem that engineering has not yet addressed."

PSC Engineering Doctrine · Hand Exposure in Integrated Steel Plants, Version 2.0

APPENDIX A CONCLUDES HERE · CONTINUES AT
Appendix B — LoadGrab® Interaction Library

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Appendix A · Final Section

Engineering Interface Selection Guide

A practical decision framework for identifying the appropriate Engineering Interface Family for any manual task. This guide consolidates the six families presented in Appendix A into a single navigation reference — from task observation to interface selection.

HOW TO USE THIS GUIDE

Engineering interface selection begins with the task — not with the product. Before reaching for a catalogue, observe what the worker's hand is doing and why it is doing it. The correct interface family will follow from that observation. This guide provides the route from observation to selection in four steps.

The first question is never "which product?" The first question is "what interaction is the worker performing — and why does the hand need to be there to perform it?"

STEP 1 — OBSERVE THE INTERACTION

Before selecting an interface, observe the task without assumptions. Identify the specific moment at which the hand enters the hazard zone — not the task in general, but the precise stage at which exposure occurs.

①

What is the worker trying to achieve?

Describe the task outcome — not the tool being used. "Align the coupling" rather than "use a bar." The outcome defines the interaction; the tool is what the interface will replace.

②

At what stage does the hand enter the hazard zone?

Map the precise moment — lift-off, final alignment, the strike, the retrieve. The exposure is rarely the whole task. It is usually one stage within it. The interface must address that stage specifically.

③

Is direct hand contact actually necessary?

In most cases, the answer is no. The hand is present because no engineered alternative exists — not because the task physically requires it. That distinction is the starting point for interface selection.

APPENDIX A · CONTINUED

Engineering Interface Selection Guide

STEP 2 — IDENTIFY THE PRIMARY INTERACTION TYPE

Almost every manual task can be reduced to one primary interaction. Identify the interaction that dominates the hand exposure — this is the interaction the engineering interface must address.

Interaction	What the worker is doing	→ Interface Family
Guide / Stabilise	Directing, steadying, or preventing rotation of a suspended or moving load	F1 — Load Control
Push / Pull / Align	Transferring positioning force to a component at the final stage of installation or assembly	F2 — Position & Reach
Lift / Carry / Retrieve	Manually handling a component within the manual handling range — no designed grip point available	F3 — Manual Lifting
Hold During Impact	Holding a chisel, punch, or drift at the work face while a hammer blow is applied	F4 — Striking & Alignment
Retrieve from Surface	Lifting a ferrous component from a flat surface with no clearance beneath it	F5 — Magnetic Handling
Task-Specific Access	Recurring interaction involving a specific object geometry or access constraint not covered by F1-F5	F6 — Specialised Maintenance

STEP 3 — MATCH THE OBSERVATION TO THE INTERFACE FAMILY

Use the matrix below to move from a task observation directly to the appropriate interface family. Each row states the observation as it would appear in the field — not in engineering language, but as a supervisor or safety engineer would describe it.

Task observation	Engineering question	Interface family	Appendix A ref
Hand touches a suspended or moving load to guide or steady it	Can guidance occur from a safe standoff distance without hand contact with the load face?	Load Control	F1 · A-2
Fingers enter the gap between two converging surfaces during final positioning	Can the positioning force be transferred to the interaction point through an engineered interface?	Position & Reach	F2 · A-6
Worker reaches into a confined space or behind guarding to adjust a component	Can the reach be extended so the hand remains outside the restricted geometry?	Position & Reach	F2 · A-6
Fingers slide beneath a component to lift it from a surface	Can the component be lifted from above — without fingers entering the space beneath it?	Manual Lifting (non-ferrous) or Magnetic Handling (ferrous)	F3 · A-10 / F5 · A-18
Worker grips a cylindrical, smooth, or irregular component with no designed carry point	Can the coupling between worker and load be improved through a designed attachment?	Manual Lifting	F3 · A-10
One worker holds a chisel or punch while another strikes it	Can the holding function be transferred to a mechanical interface — removing the hand from the strike axis?	Striking & Alignment	F4 · A-14
Fingers are inserted through a grating or beneath a steel plate to retrieve it	Can a magnetic interface attach from above and lift without finger entry beneath the component?	Magnetic Handling	F5 · A-18
Worker repeatedly improvises the same tool or grip method for the same task	Does the task present a recurring interaction that no standard family addresses? Is an engineered interface needed?	Specialised Maintenance	F6 · A-22

STEP 4 — APPLY THE ENGINEERING HIERARCHY

Engineering interfaces occupy a defined position within the broader hierarchy of controls. Before selecting an interface, confirm that higher-order controls have been considered. An interface is the correct response when the interaction cannot be eliminated or fully mechanised.

1

Eliminate the interaction

If the task can be redesigned so that no manual interaction is required, this is always the preferred engineering outcome. Ask whether the need for the interaction itself can be removed before introducing a tool to manage it.

↓

2

Mechanise the interaction

Where the interaction cannot be eliminated, assess whether it can be performed by a crane, hoist, manipulator, or powered device — removing the manual element entirely.

↓

3

Engineer the interaction — select the interface family

Where manual involvement remains necessary, select the appropriate Engineering Interface Family from Appendix A. The interface does not make the unsafe method safer. It replaces the unsafe method with one that does not require the hand to enter the hazard zone.

↓

4

Administrative controls

Procedures, training, and supervision — applied to the engineered method, not as a substitute for it.

↓

5

SIX ENGINEERING INTERFACE FAMILIES — QUICK REFERENCE

The six families of Appendix A are summarised below as a single-page reference. Each card states the engineering condition that defines the family, the primary interaction it addresses, and the doctrine principle that governs it.

F1 · A-2

Load Control Interfaces

When: the hand contacts a suspended, slewing, or translating load to guide, steady, or position it.

Primary interaction: Guide · Stabilise · Anti-rotate

Doctrine: Control the load through the interface — not through the hand.

F2 · A-6

Position & Reach Interfaces

When: the hand enters a pinch zone, crush zone, or confined geometry to push, pull, align, or separate a component.

Primary interaction: Push · Pull · Align · Separate

Doctrine: Move the point of control away from the point of contact.

F3 · A-10

Manual Lifting Interfaces

When: a component within the manual handling range has no designed grip point — and the worker improvises a hold on an edge, end, or surface.

Primary interaction: Lift · Carry · Retrieve

Doctrine: The hand is not failing. The interface is missing.

F4 · A-14

Striking & Alignment Interfaces

When: one hand holds a chisel, punch, or drift at the work face while impact force is applied — placing the holding hand on the strike axis.

Primary interaction: Hold During Impact

Doctrine: The hand should never share the hammer's path.

F5 · A-18

Magnetic Handling Interfaces

When: a ferrous component must be retrieved from a flat surface with no clearance beneath it — and fingers must enter the gap to establish a grip.

Primary interaction: Retrieve · Lift from above · Ferrous guidance

Doctrine: Retrieve from above — not from underneath.

F6 · A-22

Specialised Maintenance Interfaces

When: a recurring task involves a specific object geometry or access condition that no standard family addresses — and the current method is improvised.

Primary interaction: Task-specific · Recurring improvisation

Doctrine: Repeated improvisation is evidence that an engineered interface is needed.

APPENDIX A · CONTINUED

Engineering Interface Selection Guide

LOOKING BEYOND PRODUCTS

Throughout Appendix A, representative interfaces have been presented to illustrate how engineering principles translate into practical tools. The purpose of those profiles has never been to prescribe a single product for every task. The more important outcome is the development of an engineering habit of mind.

When observing any manual activity in a steel plant, engineers and supervisors should habitually ask four questions: What interaction is taking place? Why does the hand enter the hazard zone at that moment? Can the interaction be redesigned? Can an engineered interface perform the same function with the hand outside the hazard zone?

By asking those questions consistently — across departments, during shutdowns, during routine maintenance planning — the opportunities to reduce unnecessary hand exposure become visible. Individual interfaces will change as products evolve. The engineering questions remain constant.

Concluding Doctrine · Appendix A

"When a task repeatedly requires the worker's hand to enter a hazard zone, the first engineering question should not be 'How do we protect the hand?' It should be 'Can we redesign the interaction?' If that question becomes part of routine engineering practice, the concept of hands-free working moves beyond individual tools and becomes an integral part of how work in integrated steel plants is planned, maintained, and improved."

PSC Engineering Doctrine · Hand Exposure in Integrated Steel Plants, Version 2.0 · Published by PSC Hand Safety India Private Limited

CENTRAL PRINCIPLE

ENGINEER THE HAND OUT OF THE HAZARD.

A practical framework for identifying and reducing direct hand exposure in integrated steel-plant operations.

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